

This is to certify that the
dissertation entitled

EXPLAINING VARIATIONS IN THE USE OF THE INTERNET
TO SUPPORT INTER-ORGANIZATIONAL EXCHANGE:
THE CASE OF THE RECYCLING INDUSTRY

presented by

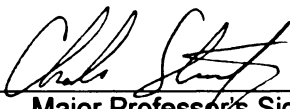
THOMAS ADELAAR

has been accepted towards fulfillment
of the requirements for the

Ph.D.

degree in

MEDIA AND INFORMATION
STUDIES



Major Professor's Signature

12/12/05

Date

MSU is an Affirmative Action/Equal Opportunity Institution

LIBRARY
Michigan State
University

PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.
MAY BE RECALLED with earlier due date if requested.

DATE DUE	DATE DUE	DATE DUE
OCT 27 2007		

**EXPLAINING VARIATIONS IN THE USE OF THE INTERNET TO SUPPORT
INTER-ORGANIZATIONAL EXCHANGE:
THE CASE OF THE RECYCLING INDUSTRY**

VOLUME I

By

Thomas Adelaar

A DISSERTATION

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

DOCTOR OF PHILOSOPHY

Department of Telecommunications, Information Studies and Media

2005

ABSTRACT

EXPLAINING VARIATIONS IN THE USE OF THE INTERNET TO SUPPORT INTER-ORGANIZATIONAL EXCHANGE: THE CASE OF THE RECYCLING INDUSTRY

By

Thomas Adelaar

Internet tools, including auctions and other forms of electronic market mechanisms, can reduce transaction costs in inter-organizational exchange, such as those incurred during search and price discovery. Based on these advantages, many studies grounded in transaction cost economics predicted a high use of brokerage-like Internet tools such as Web-based auctions within business-to-business trading. Curiously, the usage of these tools is low in many industrial sectors, while the use of communication-like Internet tools (e.g., email) is high. These variations suggest that a transaction-cost theory approach may not fully explain why firms use particular Internet tools to coordinate transactions. This study develops a framework that complements the underlying antecedents of the use of Internet tools derived from transaction cost theory with additional factors rooted in social, relational and evolutionary aspects of inter-organizational behavior.

Exploratory and confirmatory case studies are conducted on a group of firms in the recycling industry that process and wholesale non-ferrous scrap metal. This industry is selected because it is an industrial sector that suffers from high transaction costs and

stands to benefit greatly from the use of Internet tools. Hence it is a suitable setting in which to investigate the factors that constrain and/or promote the use of Internet tools.

The findings show that most recyclable material wholesalers did, in fact, use the Internet to support scrap metal transactions and reduce transaction costs. However, this usage was for communication and information-seeking, rather than for more sophisticated trade support. Case study firms used online services to receive real-time price updates of commodity exchanges and subsequently reduce price uncertainty costs. Email was also widely used to, for example, exchange digital pictures, reducing the cost of assessing the quality of recyclable materials and the cost to resolve a buyer's complaint. In contrast, only a few wholesalers used a Web-based auction to sell low-grade scrap materials to mostly Asian buyers. Most of the firms in the study refrained from the use of Web-based auctions because auctions were regarded as tools jeopardizing existing business relationships and inter-organizational routines, which increased safeguarding costs.

The findings largely support the proposed framework, and provide a greater understanding of variations in the ways that firms use the Internet to support inter-organizational exchange. Previous studies underestimated the fact that Web-based auctions imply a radical new price discovery mechanism disrupting existing negotiations, relationships and routines, whereas the use of real-time data feed services and email complement existing ways of doing business. As a result, previous studies have overestimated the potential for industry-wide use and effects of brokerage-like tools, and underestimated the use and effects of communication-like tools.

Copyright by
Thomas Adelaar
2005

ACKNOWLEDGEMENTS

This dissertation is the result of a fascination for technological opportunities and challenges affecting people, businesses and society. I am very grateful to my advisor and major Professor Dr. Charles Steinfield at Michigan State University for his guidance, insights, enthusiasm, constructive feedback and support in conducting this dissertational study. This dissertation would not have been possible without his constructive and constant support. I would also like to thank his wife Susan, along with the rest of his family for their great hospitality.

I want also like to express my gratitude to my committee, Robert LaRose, Steve Wildman, Hairong Li and Brian Pentland for their guidance, encouragement, suggestions, invaluable advice and comments. I would further like to thank my former and current colleagues in the Department of Telecommunications, College of Communication Arts and Sciences and the Community and Economic Development Program: Johannes Bauer, Mark Levy, Stephen Lacy, Charles Salmon, Rex LaMore, John Melcher, Kenneth Corey and Mark Wilson, for their suggestions, discussions and hospitality, and for making my stay enjoyable and rewarding. Also, I want to thank my current colleagues at the Department of Accounting and Information Management at Maastricht University in particular Rita Walczuch and Mark Vluggen for their support and feedback. Also, I would like to thank the participants of the 'Americas' Conference on Information Systems specifically Varun Grover and Rolf Wigand both of whom gave feedback and suggestions.

I am also grateful to the individuals and organizations who participated in this study, such as the recyclable material wholesalers and Internet entrepreneurs.

I also would like to thank the Native Americans I met, such as Gordon Henry and others for their hospitality, kindness, inspiration, and humor. I would also like to thank the people of Greater Lansing, Michigan, and the United States, who showed me hospitality and helped me gain a greater understanding and respect for the American way of life.

During my stay in Michigan and the States, I was privileged to meet many people and make new friends. I would like to specially thank Chad, Pete, Lisa, Aaron, Andy, Harrie, Erica, Michiel, Regina and Katie for their support, company, making my stay joyful and for helping me endure the trials and tribulations of graduate school. Also I would like to thank my former colleagues at the Telematica Instituut, and the participants of the Edispuut such as Tibert Verhagen and Cristian Hesselman. Further, I would like to express my thanks to all the other people I have met and did not mention explicitly, who all were instrumental in the completion of my dissertation..

Finally, a special word of thanks to my parents Louise and Rens as well as my sister Annette for their invaluable suggestions, encouragements, support and perseverance in the pursuit of knowledge and happiness.

Thomas Adelaar

Maastricht, December, 2005

TABLE OF CONTENTS

ACKNOWLEDGEMENTS.....	V
TABLE OF CONTENTS.....	VII
LIST OF TABLES	XI
LIST OF FIGURES	XII
1. INTRODUCTION.....	1
1.1. Benefits of Internet tools.....	1
1.2. Electronic markets and transaction costs	4
1.3. The recycling industry and electronic markets	6
1.4. Apparent contradiction and paradox.....	7
1.5. Moving towards an integrated framework.....	10
1.5.1. Complementary theories and interdependencies	11
1.5.2. Social construction and the structuration of technology use.....	13
1.6. Research questions.....	14
1.7. Purpose.....	15
1.8. Contribution.....	16
1.9. Outline.....	17
2. THEORY REVIEW	18
2.1. Internet tools.....	18
2.2. Antecedents, use and effects of Internet tools	21
2.2.1. Markets	21
2.2.2. Inter-organizational exchange	22
2.2.3. Transactions.....	24
2.3. Transaction cost theory	25
2.3.1. Behavioral assumptions	26
2.3.2. Transaction attributes.....	26
2.3.3. Atmosphere.....	30
2.3.4. Governance structures.....	30
2.3.5. Transaction costs	32
2.4. Use and effects of electronic markets	39
2.4.1. Prediction of the move to e-markets.....	42
2.4.2. Prediction evolutionary stages of e-markets.....	44
2.4.3. Critique of studies on electronic markets.....	46
2.4.4. The recycling industry and the use of electronic markets.....	51
2.4.5. Recyclable materials and transaction attributes	55
2.5. Industry-wide use of Internet tools.....	58
2.5.1. Email	60
2.5.2. Electronic Call for Proposals and Request for Quotes	63
2.5.3. Web-based auctions	64
2.5.4. Recycling industry	65

2.5.5.	Insufficient explanations and paradox	67
2.6.	Framework	70
2.6.1.	Price discovery mechanisms.....	72
2.6.2.	Transaction attributes.....	75
2.6.3.	Capabilities of Internet tools.....	81
2.6.4.	Value-to-weight ratio	85
2.6.5.	Relational embeddedness.....	86
2.6.6.	Variability of demand and joint planning.....	97
2.6.7.	Inter-organizational routines.....	100
2.6.8.	Interdependencies.....	106
3.	METHODS	119
3.1.	Justification of performing qualitative case studies.....	119
3.2.	Exploratory and confirmatory aspects case studies	121
3.2.1.	Exploratory aspects case studies.....	121
3.2.2.	Development of theoretical framework.....	122
3.2.3.	Influence of inter-organizational exchange properties.....	123
3.3.	Unit and level of analysis.....	125
3.4.	Instrumentation.....	127
3.4.1.	Construct specification	127
3.4.2.	Case study protocol	130
3.4.3.	Interview procedures.....	131
3.5.	Sampling strategy.....	133
3.5.1.	Selection of recyclable material wholesalers.....	133
3.5.2.	Multiple case study design	134
3.5.3.	Replication logic	136
3.5.4.	Sampling parameters	137
3.5.5.	Qualifying criterion and case selection	138
3.5.6.	Overview of targeted organizations and firms	139
3.6.	Analytical strategies	145
3.6.1.	Description and interpretation	145
3.6.2.	Exploratory case studies	146
3.6.3.	Confirmatory case studies.....	148
3.7.	Quality of the case studies	151
4.	FINDINGS	155
4.1.	Case background: Value chain analysis of the recycling industry	155
4.1.1.	Generation of scrap.....	159
4.1.2.	Collection	162
4.1.3.	Processing	163
4.1.4.	Brokerage.....	175
4.1.5.	Consumption	177
4.2.	Use and effects of Internet tools.....	179
4.2.1.	Abundant use of online price information services	179
4.2.2.	High use of email	181
4.2.3.	Low use of Web-based auctions	183
4.2.4.	Overview of propositions.....	185

4.3.	Transaction attributes	186
4.3.1.	Real-time data feed services and price uncertainty.....	186
4.3.2.	Email use and price uncertainty	193
4.3.3.	Auction use and price uncertainty	196
4.3.4.	Real-time data feed services and email: Product specificity.....	201
4.3.5.	Auction use and product specificity	201
4.3.6.	Real-time data feed services and frequency	207
4.3.7.	Email and frequency	207
4.3.8.	Auction use and frequency.....	208
4.4.	Internet capabilities	211
4.4.1.	Real-time data feed services and connectivity	211
4.4.2.	Email connectivity	212
4.4.3.	Auction use and connectivity.....	215
4.4.4.	Real-time data feed services and digital representation.....	218
4.4.5.	Email use and digital representation	219
4.4.6.	Auction use and digital representation	225
4.5.	Relational embeddedness.....	227
4.5.1.	Real-time data feed services.....	227
4.5.2.	Email	230
4.5.3.	Auction use	236
4.6.	Joint planning and demand variability	244
4.6.1.	Real-time data feed services.....	244
4.6.2.	Email	244
4.6.3.	Auction use	246
4.7.	Inter-organizational routines	250
4.7.1.	Real-time data feed services.....	250
4.7.2.	Email	251
4.7.3.	Auction use	253
4.8.	Structuration of the use of Internet tools.....	255
4.8.1.	Real-time data feed services.....	255
4.8.2.	Email	258
4.8.3.	Auction use	262
4.9.	Overview of findings	268
5.	DISCUSSION	276
5.1.	Antecedents of the use of Internet tools	276
5.1.1.	Transaction attributes.....	278
5.1.2.	Internet capabilities	284
5.1.3.	Relational embeddedness.....	287
5.1.4.	Joint planning and demand variability	290
5.1.5.	Inter-organizational routines.....	292
5.2.	Effects	298
5.2.1.	Interdependencies.....	302
5.3.	Support for conceptual framework.....	306
5.3.1.	Underestimation and overestimation.....	307
5.4.	Emergent findings	309
5.4.1.	Structuration of use in real-time data feed services	309

5.4.2.	Structuration of email use: Underestimated and misunderstood .	310
5.4.3.	Structuration of the use of Web-based auctions.....	314
5.4.4.	Social construction	316
5.4.5.	Communication and brokerage-like Internet tools	318
5.4.6.	Speculations on EMH and evolutionary stages of e-markets	321
5.4.7.	Further specification of framework and propositions	323
6.	CONCLUSIONS	325
6.1.	Support for framework and its implications.....	325
6.2.	Limitations	329
6.3.	Future research	331
APPENDIX A: Explanatory case studies of scrap metal wholesalers		333
APPENDIX B: Characteristics of scrap metal wholesalers		334
APPENDIX C: Additional explanatory case studies.....		335
APPENDIX C: Additional explanatory case studies.....		336
APPENDIX D: Exploratory case studies		337
APPENDIX E: Scrap metals sold at online auction.....		339
REFERENCES		340

LIST OF TABLES

Table 1: Relative economic costs for markets and hierarchies.....	38
Table 2: Value chain for recyclable materials by industry sector.....	157
Table 3: Change of the recycling industry between 1992, 1997, and 2002.....	165
Table 4: Geographical markets of recyclable materials wholesalers in 1997.....	168
Table 5: Recyclable material wholesalers by type of business, US, 2002.....	170
Table 6: Annual volume of processed recyclable materials each in the US.....	173
Table 7: Wholesale trade agents and brokers of recyclable materials, 2002.....	176
Table 8: Skeptics' reactions when asked about Web-based auction use.....	239
Table 9: Antecedents and effects of the use of real-time data feed services.....	273
Table 10: Antecedents and effects of the use of email.....	274
Table 11: Antecedents and effects of the use of Web-based auctions.....	275
Table 12: Inter-organizational exchange properties and Internet use.....	296
Table 13: Effects of Internet tools on coordination costs.....	300
Table 14: Effects of Internet tools on safeguarding costs.....	300
Table 15: Effects of the use of Internet tools on transaction costs.....	301
Table 16: Effects of the use of Internet tools on price discovery mechanism.....	305

LIST OF FIGURES

Figure 1: Generic framework on the antecedents, use and effects of Internet tools	21
Figure 2: Logic TCT	38
Figure 3: Basic logic of transaction costs and use Internet tools	44
Figure 4: Evolutionary stages electronic markets and the two effects	45
Figure 5: Effects of transaction costs on the evolution of e-markets	50
Figure 6: Basic framework	70
Figure 7: Inter-organizational exchange properties	71
Figure 8: Transaction attributes	80
Figure 9: Connectivity capabilities to facilitate exchange	83
Figure 10: Relational embeddedness	96
Figure 11: Inter-organizational routines and the use of Internet tools	106
Figure 12: Detailed framework of Internet tools' antecedents, use and effects	107
Figure 13: Unit of analysis: Inter-organizational exchange	125
Figure 14: Level of analysis	126
Figure 15: Value chain of the recycling industry: A process view	156
Figure 16: Sales of recyclable materials wholesalers by product category, 2002	171
Figure 17: Sustained propositions on real-time data feed services	269
Figure 18: Sustained propositions on email use	270
Figure 19: Sustained propositions on the use of Web-based auctions	271
Figure 20: Sustained propositions on the non-use of Web-based auctions	272
Figure 21: Emergent framework	324

1. INTRODUCTION

This dissertation will focus on the antecedents, use and effects of Internet tools in inter-organizational exchange, and will test the commonly-held expectation that the use of communication and brokerage-like Internet tools (e.g., email and Web-based auctions) reduces transaction costs. The scrap and recycling trade will be the industry sector under scrutiny, as its conditions form a theoretical incentive for the use of brokerage-like Internet tools. However, an apparent contradiction between theoretical predictions and the actual use of Internet tools was revealed, now representing the basis for the problem statement. A framework was developed through a synthesis of complementary aspects of transaction costs theory, social embeddedness and evolutionary economics, assessing the variations in the use and effects of Internet tools. Research questions are then introduced to assess these variations. Thereafter, the study's purpose is finally discussed in greater detail, in addition to the study's theoretical contribution. To close, the outline of the dissertation will be presented.

1.1. *Benefits of Internet tools*

A range of business-to-business (hereafter B2B) markets are confronted with high costs of inter-organizational exchange (e.g., trading activities and transactions), which reduce the benefits gained from trade. Inter-organizational exchange enables firms to specialize and reduce production costs, thereby promoting wealth creation. High costs of exchange

(e.g., transaction costs) reduce opportunities for trade, which in turn may lower social welfare and lead to a sub-optimal allocation of resources throughout the economy.

The capabilities of Internet tools can facilitate communication (e.g., email), provide market functions (e.g., price discovery mechanisms such as auctions) and market roles (e.g., electronic brokerage). Communication and brokerage functions may be underdeveloped within some industry-focused B2B markets (Bakos, 1998). Internet tools are thought to support, enhance and facilitate online exchange by enabling a reduction of transaction costs, such as search and price discovery costs (Bakos, 1998; Malone, Yates, & Benjamin, 1987). Moreover, Internet tools may help improve the control and monitoring of transactions. The subsequent use of Internet tools can then increase the efficiency and effectiveness of inter-organizational exchange.

The recycling industry is an industry confronted with a relatively complex nature of exchange, resulting in relatively high transaction costs. For example, recycling materials wholesalers process, sort, aggregate and densify¹ many different varieties of recyclable materials (e.g., ferrous and non-ferrous scrap metals, used paper and plastics). These materials are often heterogeneous in quality and content since they are generated from many different geographical and industry sources (e.g., metal processing plants).

¹ Recyclable material wholesalers use machines to closely compress and bundle loose materials in a wrapped packet.

Theoretically, the use of Internet tools would bring great advantages to these exchanges, such as a decrease in the relatively high transaction costs. First, the process of trading the many different variations of processed recyclable materials (e.g., scrap metal) creates uncertainty among market actors concerning the quality and content alluded to above. Sellers need to exchange detailed information with potential buyers (e.g., steel mills and foundries) to reduce this uncertainty, by performing an assessment of the quality of the recyclable materials, subsequently improving the capability of the buyer to process the materials without any problems. This information exchange may benefit the sellers by reducing the occurrence of costly rejections of shipments and downgrades (e.g., price reduction). The use of email, in the form of sharing digital pictures of the materials up for sale, may reduce communications costs. Second, the price uncertainty in relation to recyclable materials is relatively high, due to large and rapid fluctuations in the prices of underlying commodities. The use of online real-time financial information systems such as Bloomberg.com provide market actors with greater and improved access to information and enable market actors to make quicker and more informed decisions. Third, this uncertainty, in regards to prices and demand, acts as an incentive for recyclable materials wholesalers to contact multiple buyers, to solicit price quotes and negotiate a particular deal. Solicitations and negotiation can be a complicated and time-consuming effort. Instead, sellers may use Web-based auctions, which automatically process bids from interested sellers online, improving the efficiency of the price-determination process.

1.2. *Electronic markets and transaction costs*

Transaction cost theory (hereafter TCT) (Coase, 1937; Williamson, 1975, 1985) has provided the theoretical foundation for many studies of the effects (e.g., transaction cost reduction) of the use of Internet tools. TCT assumes that firms try to minimize both production and transaction costs. Firms can opt for two basic governance structures, markets or hierarchies (e.g., organization). This choice has the potential to reduce transaction costs and is influenced by transaction attributes (e.g., the complexity of product description). Firms confronted with a high cost of doing business across markets (e.g., from high uncertainty about quality of products) may raise transaction costs and limit trade. Transaction cost theory predicts that they may opt for in-house production to minimize these costs.

However, it is argued that the development and the use of Internet tools would facilitate communication (e.g., email) and brokerage capabilities (e.g., Web-based auctions), thereby reducing the costs of market transactions (Bakos, 1998; Kaplan & Sawhney, 2000; Malone et al., 1987). The reduction of transaction costs provides incentives for firms to buy products across markets in favor of in-house production (Malone et al., 1987). Malone *et al* and many other scholars after them followed this logic to predict a move from non-electronic hierarchies and non-electronic markets towards electronic markets, often referred to as the electronic market hypothesis (EMH) (Bakos, 1998) (Clemons, Reddi, & Row, 1993).

In addition, Malone *et al* predicted several evolutionary stages of e-markets. Improved communication facilitated by Internet tools would trigger the emergence of biased e-markets. The reduction of transaction costs was limited, since the e-market was biased towards a single buyer. However, the development of brokerage capabilities offered by Internet tools (e.g., Web-based auctions) would generate the rise of unbiased e-markets (e-market participation of multiple sellers and buyers), providing an even greater reduction of transaction costs. Thus it can be concluded that the use of communication and brokerage-like Internet tools results in a reduction of transaction costs. Such a reduction may be an indication of the two stages of e-markets and may possibly provide an indirect indication of a move towards e-markets.

1.3. *The recycling industry and electronic markets*

The recycling industry is confronted with relatively high costs of doing business, as has been argued above. For example, the generation of recyclable materials (often incorrectly referred to as waste) occurs within multiple economic sectors. Generation and consumption are geographically dispersed and occur unevenly across time. Both inter-industry (e.g., recyclable materials processors and steel mills/foundries) and intra-industry trade (exchange of unprocessed and semi-processed metals among processors) is therefore necessary to aggregate materials in a manner that allows efficient processing and preparation. Such activities are typically managed by so-called recyclable material wholesalers. Recyclable material wholesalers face several business challenges while selling their materials, such as uneven distribution of information between buyers and sellers, uncertainty about product value due to great fluctuations in underlying commodity prices and variability in demand (e.g., consumers of scrap metal such as steel mills may reduce demand in response to declining demand).

As noted earlier, Internet tools have been proposed as a remedy for high transaction cost problems, particularly those that plague the recyclables industry. Based on the predictions of Malone *et al*, we would expect a high use of communication-like Internet tools (e.g., email) by market actors in the recycling industry. In addition, brokerage-like Internet tools are assumed to offer greater benefits in comparison to communication-like tools, so one could expect to observe a relatively large use of brokerage-like Internet tools in the recycling industry.

1.4. *Apparent contradiction and paradox*

Despite the success of third-party owned consumer-to-consumer (C2C) and business-to-consumer auctions such as eBay.com², the trade volume and the number of participants in third-party owned B2B web-based auctions is relatively small. Data from the US Census Bureau, academic studies and consultancy reports show that the use of third-party electronically-brokered markets (including demand/supply aggregation and Web-based auctions) is low. For example, according to the annual survey of the US Census Bureau in 2001, industry merchant wholesalers (including recyclable material wholesalers) conducted online sales in excess of \$272 billion. Studies of the US Census Bureau also show that businesses are reluctant to use electronic markets controlled by third parties. For example, the share of third-party owned wholesale electronic markets within the US economy (referring to establishments which do not take title on the goods and services traded) was \$2.7 billion in 2002. This figure is only about 1% of total sales in merchant wholesale trade conducted offline. Also within the manufacturing industry (including the major buyers of recyclable materials such as steel mills and foundries) the use of third-party owned wholesale e-markets is less than 0.5% of total online sales (US Census, 2005).

² It was predicted that C2C Internet auctions would have a turnover of \$52.6 billion by 2002 (Forrester Research, 1999).

Although the US Census Bureau does not report on email use individually, academic studies and consultancy reports indicate that, contrary to the predictions of Malone *et al*³, the communication-like Internet tool email is the most widely-used e-business tool by firms throughout the economy to initiate, manage and complete transactions online (Verhoest et al., 2003). Email can be use for asynchronous personal communications between firms and/or to send a message to multiple firms at once. For example, a study by Dun and Bradstreet showed that 79% of small businesses in the US (with less than 25 employees) used the Internet in 2002 (Dun & Bradstreet, August 2002)⁴. Furthermore, an academic study performed in France, Germany, Italy and the UK revealed that email was used by most of the respondents (87.4%). By comparison, only 23.4% of the respondents used electronic data interchange (EDI) (Verhoest et al., 2003).

³ Malone *et al* argued that brokerage-like tools would offer greater benefits than communication-like tools, leading us to expect brokerage-like tools being more popular in use than communication-like tools in business transactions.

⁴ Center for Research on Information Technology and Organizations (CRITO), International Data Corporation (IDC), August 2002.

Even when industry and product conditions seem favorable, as they appear in the recycling industry, the use of brokerage-like Internet tools is relatively low in B2B trade. The predictions of Malone *et al* offer no viable explanation regarding the observation that companies still use one of the most relatively simple communication-like Internet tools, instead of a more complex brokerage-like Internet tool. The differences between these observed patterns of use and the predictions of the EMH grounded in TCT therefore raise the following **general research question**:

Why do some industries which are confronted with relatively high transaction costs (such as the recycling industry) have a relatively low use of the supposedly more efficient, automated and brokerage-like Internet-based tools (e.g., Web-based auctions), and instead rely on relatively simple communication-like tools (e.g., email) to engage in inter-organizational exchanges?

1.5. *Moving towards an integrated framework*

The variations in use of different types of Internet tools within industries (e.g., recycling) provide indications that secondary data are not sufficiently and satisfactorily explained by the underlying behavioral assumptions of the EMH. The variations in the use of Internet tools may imply that a) the uptake in use is more complex, and other factors/dimensions of exchange interact with transaction attributes, b) the variations in use of Internet tools indicate a lack of uniform effect on transaction costs by communication and brokerage-like Internet tools or c) the use of brokerage-like Internet tools may jeopardize existing mechanisms to reduce transaction costs, thus outweighing their benefits.

Previous studies of the use and effects of Internet tools may have over-simplified, misrepresented, or too-narrowly interpreted the complex nature and multifaceted properties of inter-organizational exchange occurring within industries. For example, Malone *et al* and many other studies on the use and effects of Internet tools grounded in TCT, ignore the fact that transactions take place within a “trading atmosphere” (Williamson, 1975, p.37)⁵ which may reduce opportunism (Gander & Rieple, 2004). Atmosphere refers to the fact that market actors may value or prefer a specific governance structure for inter-organizational exchange over another. The failure to incorporate and

⁵ “A more satisfying trading atmosphere sometimes obtains” (Williamson, 1975).

specify the atmosphere concept, and more generally, the social, relational and evolutionary aspects of inter-organizational exchange, may have distorted the assumptions related to the uptake of electronic markets.

To increase conceptual clarity and further specify the antecedents of the use of Internet tools, I propose an integrated framework for inter-organizational exchange. This framework considers transaction attributes and IT capabilities as so-called inter-organizational exchange properties. The integrated framework may increase the understanding of the influence of exchange properties on the use and effects of Internet tools. The specification of exchange properties and the identification of interdependencies among them may provide possible explanations for the apparent contradictions between the EMH and observed patterns of Internet use.

1.5.1. Complementary theories and interdependencies

A further specification of inter-organizational exchange properties requires the synthesis of TCT with complementary theories on the motives of market actors, namely social embeddedness (Granovetter, 1985; Uzzi, 1997) and the evolutionary perspective on routines (Nelson & Winter, 1982). Proponents of the social embeddedness approach to business relationships argue that cooperative motives of firms complement the behavioral assumptions of TCT (Ring & van de Ven, 1994; Uzzi, 1997). Business relationships are embedded within social structures that enable the formation of trust, information sharing and joint-problem solving, which facilitate and streamline inter-organizational exchange (Uzzi, 1997).

Many studies grounded in TCT of e-markets do not consider the social embeddedness of relationships in addition to inter-organizational exchange routines, which may have led to a potential underestimation of the interdependencies between the introduction of Internet capabilities, business relationships, and routines. For example, the use of auction functions may imply the introduction of a new price discovery mechanism, while it may be customary in an industry that firms determine prices through (bilateral) negotiations. Thus, the introduction of Web-based auctions within certain industries could require multiple changes in the way firms determine prices, as well as in the way they do business. Such changes may not be preferred, since negotiations may enable firms to build business relationships which reduce transaction costs (Uzzi, 1997). Web-based auctions could therefore threaten or disrupt existing business relationships. Further, inter-organizational routines may enable firms to quickly compare business proposals from multiple firms. For these reasons, market actors may conclude that Web-based auctions do not “match” their existing way of doing business and simply refuse to use new Web-based auctions. The integrated framework incorporates the interdependencies discussed above. To the author’s knowledge such integration has not previously been performed⁶.

⁶ It should be noted that previous studies attempted to integrate social embeddedness and also routines with TCT, respectively.

1.5.2. Social construction and the structuration of technology use

Certain Internet tools applications could have a greater fit with existing inter-organizational (and thus industry-wide) exchange routines than others. The degree of match/fit between new and existing trading practices could be associated with the use or non-use of particular Internet tools applications. However, market actors may anticipate technological developments, by adapting, modifying or reinventing the capabilities of Internet tools, to fit the tools according to the way firms do business. The approach which describes the process of adapting technology use is referred to as the structuration of technology use (Desantis & Poole, 1994; Orlikowski, 2000). For example, “simple” Internet tools applications might evolve in such a way, which may provide a range of benefits not previously identified. The interdependencies between the properties of inter-organizational exchange could help increase our understanding of the conditions influencing the “unpredicted” variations in the use and effects of Internet tools.

The structuration of technology use and social construction of technology approach complements the behavioral assumptions in transaction cost theory and relational embeddedness. A revised framework specifying inter-organizational exchange properties and the interdependencies among them, and incorporating their effect on use, structuration of use and social construction, could further explain variations in the use of Internet tools, as well as their effects on transaction costs.

1.6. *Research questions*

From the previous discussion, the following research questions (RQ) are derived:

- **Research Question 1:** What are the properties of inter-organizational exchange relevant to the use of Internet tools?
- **Research Question 2:** How do inter-organizational exchange properties influence the use of communication and brokerage-like Internet tools?
- **Research Question 3:** How does the use of communication and brokerage-like Internet tools affect transaction costs?
- **Research Question 4:** How do the interdependencies between the inter-organizational exchange properties influence the use of Internet tools and the effects on transaction costs?
- **Research Question 5:** How does the structuration of the use of Internet tools affect transaction costs?

1.7. Purpose

The purpose of this study is to test and validate the common expectation that the use of communication (e.g., email) and brokerage-like Internet tools (e.g., Web-based auctions) reduces transaction costs. To do so, this study pursues the development of an integrated theoretical framework on inter-organizational exchange properties which can explain the variations in the use and effects of Internet tools. This theoretical integration is sought by combining transaction costs theory with complementary theoretical approaches concerning relational, social and evolutionary aspects of inter-organizational exchange. An integrated framework which incorporates complementary theories to TCT can play a greater role in itself. For example, the field of theoretical physics also strives to create a unified theory or "theory of everything," a goal that is driven by the problems that similar phenomena can be explained by two major theories, namely quantum mechanics and the theory of relativity. Through an analysis of the recycling industry (being confronted with relatively high transaction costs), we hope to reveal the properties of inter-organizational exchange and explain how these properties and interdependencies influence the use and effects of Internet tools, in situations with characteristics that would appear to favor the their adoption and use.

1.8. *Contribution*

An inclusive assessment and specification of the behavioral assumptions, as well as any overlooked factors of inter-organizational exchange, enables the development of an integrated framework that includes inter-organizational exchange properties and the interdependencies among them. The development of this theoretical framework may increase the understanding of the influence of specific inter-organizational exchange properties on the variations of use of Internet tools, as well as the effect of that use on transaction costs. Furthermore, study results may improve our understanding of the underlying dynamics and complex processes of a potential reduction of transaction costs and a potential increase in the use of electronic markets. For example, a reduction of transaction costs through the use of Internet tools may explain the variations in the use and effects of communication and brokerage-like Internet tools. The effects may be indicative of two evolutionary stages of e-markets (biased and unbiased). Finally, findings may require the addition of behavioral assumptions about behavior to the TCT, in order to understand the complex process of structuration of and social construction of the use of Internet tools. A revised conceptual framework could increase our understanding of industry-wide dynamics concerning the use of Internet tools.

1.9. *Outline*

This dissertation consists of the following chapters. The second chapter reviews theories related to inter-organizational exchange, including electronic markets and TCT. Complementary theories to TCT are introduced and reviewed in areas where TCT may have led to a narrow interpretation of inter-organizational exchange. These complementary approaches help specify additional antecedents to the use of Internet tools. Propositions are derived by applying assumptions and antecedents to the characteristics of the recycling industry. The third chapter discusses the methods employed, including the rationale for performing explanatory case studies, instrumentation and analytic strategies. The fourth chapter discusses the case study background. The fifth chapter presents the findings of the study. The sixth chapter provides a discussion and interpretation of the confrontation of the findings with the propositions and research questions. The seventh chapter presents the conclusions, limitations and suggestions for further research.

2. THEORY REVIEW

2.1. *Internet tools*

Internet tools used within inter-organizational exchange cover multiple technological aspects, these being both heterogeneous and idiosyncratic, though sometimes these functionalities may overlap. Often, “Internet tools” is a broadly defined term that encompasses the variations in tools, as well as their functions. For example, the OECD defines electronic commerce as transactions between companies occurring via non-proprietary networks, such as the Internet (OECD, 2002). The US Census Bureau provides a slightly more specific definition of e-commerce sales, namely “sales of goods and services where an order is placed by the buyer or price and terms of sale are negotiated over an Internet, extranet, Electronic Data Interchange (EDI) network, electronic mail, or other online system. Payment may or may not be made online” (U.S.CensusBureau, 2005).

The definition of the US Census Bureau is here adopted to study the use of Internet tools in inter-organizational exchange; however, this study concerns only business-to-business (hereafter B2B) trade and excludes other forms, such as business-to-consumer trade. Internet tools are often adopted by an organization jointly, or in clusters. They can easily be used in tandem, and may be built upon the user’s experience with previous Internet-

based applications (LaRose & Hoag, 1996). For example, a potential buyer at a Web-based auction can use email to communicate directly with the seller.

This study does not use the term e-commerce since it is often assumed that this definition does not include email, instead the term Internet tools are used throughout this study. This study focuses specifically on the Internet tools that are used by firms to conduct trade online; however, there is not a predefined or limited set of tools that may be studied within the recycling industry. As a result, this study identifies several types of Internet tools: those with communication-like capabilities, such as real-time data feed services, email, electronic Request For Proposals (CFPs) / Call For Quotes (RFQs); those with brokerage-like capabilities, such as Web-based auctions and supply/demand aggregation Internet exchanges; and finally, those with integration-like capabilities, such as supply chain management or collaboration tools.

Use of different types of capabilities

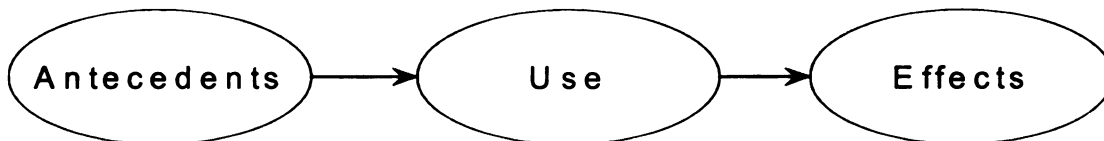
Electronic tenders such as CFPs and RFQs can be posted on websites or aggregation exchanges, to announce the offers to other firms; they can also be sent to interested parties via email. Email may be used to send additional product information like pictures or blueprints, or to finalize transactions, as when sending contracts (Turban, 2004). Meanwhile, Web-based auctions enable the efficient processing of bids. Finally, supply chain collaboration and integration are tools used by firms to automate standard transactions, like the ordering of goods, hoping to thereby reduce the amount of potential

errors (Rappa, 2004). For example, supply chain collaboration tools enable design teams of suppliers to exchange data and blueprints effectively with an assembler.

2.2. *Antecedents, use and effects of Internet tools*

Many studies on the use and effects of Internet tools in inter-organizational exchange base their analysis on a common generic framework of the antecedents of the use and effects of Internet tools (Figure 1) (Byrd & Davidson, 2003; Grewal, Comer, & Mehta, 2001; Grover, 1993; Kraut, Steinfield, Chan, Butler, & Hoag, 1999). Below a specification follows of this generic framework in the context of inter-organizational exchange and the use of Internet tools.

Figure 1: Generic framework on the antecedents, use and effects of Internet tools



2.2.1. Markets

The use of Internet tools occurs within inter-organizational exchange. Exchange is conducted within markets. However, neoclassical economics has studied markets to understand production and price setting, but has often regarded the market as an abstract theoretical concept (North, 1977). It assumes that market actors (e.g., buyers and sellers) are motivated to maximize their utility (Bakos, 1998). Specialization or division of labor

enables higher economic productivity but necessitates the coordination of economic decision by the market mechanism. The allocation of goods is optimal when the benefits of trade are exhausted. The functioning of markets improves with an increase in the availability of accurate and complete information (Fama, 1970; Malkiel, 2003; Ross, Westerfield, & Jaffe, 2005). Scholars have identified so-called opaque markets, which do not function optimally due to market friction⁷ such as incomplete or distorted information and information asymmetries (Granados, Gupta, & Kauffman, 2005).

Markets in this paper are considered in the context of inter-organizational exchange, or trading activities and transactions. Markets are defined as the organized or self-organized exchange between buyers and sellers of products and/or services, within a specific segment of the industry value chain, and within a specific geographical area; for example, the exchange between steel and paper mills with recyclable material wholesalers in the United States.

2.2.2. Inter-organizational exchange

Exchange is the way market economies coordinate economic activity (Malone *et al*). Inter-organizational exchange refers to the interactions between firms, often referred to as B2B trade. Inter-organizational exchange includes trading activities and transactions. Inter-organizational exchange is defined as “the act of giving or taking one thing in return

⁷ Market friction is a state of a market which is removed from the neo-classical economics assumption of perfect market equilibrium (Bailey, 1998).

for another, or trade [such as] the exchange of goods for money, [with] reciprocal giving and receiving” (Webster.com). Inter-organizational exchange is a multifaceted and layered process which can be non-linear and can be viewed from multiple perspectives, such as economic, social or technological (Johnston & Lewin, 1994; Webster & Wind, 1972). Sellers may engage in multiple negotiations concurrently. Also, certain negotiation steps may be omitted, since transacting parties are familiar with each other.

Trading activities occurring within inter-organizational exchange include buying and selling of goods, bidding, bilateral and multilateral negotiating, bargaining, communication, brokerage and intermediation. Additionally, trade involves “the exchange of information to determine market price, to establish contracts for delivery or to exchange goods and/or services” (Webster.com). Inter-organizational exchange consists of a series of activities or phases where firms have the intent to buy or sell products or services, which may lead to a transfer of money and title (Hawkins & Verhoest, 2002; Merriam-Webster Inc., 1995). Trade activities concerning a specific transaction may last for days, weeks, or even months (Bose, Duan, & Lu, 2003). Trade activities may occur online or offline through a) consulting websites to gain information about products and services, b) a telephone call or email to solicit quotes from a firm, c) checking the availability of products on Web-based auctions and d) consulting real-time information services about news and prices of commodities. Market actors who conduct trading activities may switch between online and offline channels. For example, a seller can contact a buyer by email, negotiate prices on the phone, then send a confirmation of the final contract by fax and/or email (Steinfield, Bouwman, & Adelaar, 2002).

2.2.3. Transactions

Transaction may have both narrow and broad interpretations. A transaction may be “an exchange where a good or service is transferred across a technologically separable interface” (Williamson, 1981, p. 6). The narrow definition of a transaction focuses on one specific point in time, namely the transfer of ownership and money. However, the broad definition of transaction also includes activities occurring before and after the actual transfer, such as searching for buyers and enforcement of a contract. Others define transaction as “a communicative action or activity involving two parties or things that reciprocally affect or influence each other” (Merriam-Webster Inc., 1995). The definition of inter-organizational exchange corresponds closely to the broad interpretation of transactions. A transaction is defined in this paper as “the exchange processes whereby market participants have the intent or are actually exchanging or transferring goods, services, or funds, regardless of whether these goods or services are finally handed-over to the other party (Hawkins & Verhoest, 2002; Merriam-Webster Inc., 1995).

2.3. *Transaction cost theory*

Many studies of the antecedents, use and effects of Internet tools are grounded within transaction cost theory (Williamson, 1975), such as the works of (Bakos, 1998; Benjamin & Wigand, 1995) (Kaplan & Sawhney, 2000; Malone et al., 1987). Transaction cost theory tries to assess why transactions occur within hierarchies or are executed through markets. Firms try to minimize production and transaction costs. Standard economic theory⁸ assumes the rational behavior of market actors and a market of perfect information. However, transaction costs economists assume that information is costly to produce and transmit (Barzel, 2002). For example, market actors incur costs since they need to collect and distribute information about the products up for sale and the terms and conditions of a transaction before they can reach an agreement (Barzel, 2002). Therefore, the coordination of economic decisions results in transaction costs incurred by market actors (Douma & Schreuder, 1991; Gurbaxani & Whang, 1991; Smith, 1776). The cost of the distribution of information may lead to information asymmetry, a situation where an uneven distribution of information occurs between market participants engaging in a transaction [Akerlof, 1970 #2847][Arrow, 1963 #1776]. Information asymmetry can exist before (*ex ante*) or after (*ex post*) market participants have agreed to perform a transaction.

⁸ For example, the Walrasian model assumes that the cost of information is zero.

2.3.1. Behavioral assumptions

Transaction cost theory is based on two assumptions of human behavior, namely the bounded rationality of individuals and opportunism (Williamson, 1975; 1985, p.50). Bounded rationality assumes that individuals are not fully informed, the reason being that humans lack the capability to process all relevant information before making an objective decision, due to linguistic and neurophysiologic limits (Williamson, 1975). Scholars argue that market actors search for alternatives until they find one they regard as satisfactory (Simon, 1955).

“Opportunism refers to a lack of candor or honesty in transactions, to self-interest seeking with guile” (Williamson, 1975). Opportunistic behavior can occur when an agreement is reached to transact, *ex ante* or *ex post*. The risk that market participants may change their often unobservable behavior after a transaction is conducted, at the cost of the other party, gives rise to moral hazards (Douma & Schreuder, 1991).

2.3.2. Transaction attributes

Transaction cost theory makes assumptions regarding human behavior to explain situations in which market participants incur transaction costs due to either bounded rationality, or the desire to protect oneself against opportunistic behavior. The difficulty for market actors to assess specific inter-organizational exchange situations depends on the attributes of any given transaction, namely its complexity/uncertainty, frequency and

asset specificity. The governance mechanism (markets or hierarchies) which is capable to resolve the difficulties associated with the transaction attributes at the lowest costs ability will be preferred by market actors.

Complexity

Complexity refers to the difficulty of completing production through several specialized inputs and tasks (Jones, Hesterly, & Borgatti, 1997). An example would be the complexity of product description. Heterogeneous goods (e.g., quality and product features/characteristics) are more complex and therefore require more cost to properly describe a product and thereby reduce information asymmetry (Douma & Schreuder, 1991). Market actors have only a limited capability (bounded rationality) to comprehend the complexity of a transaction. Market participants incur cost to protect themselves against the occurrence of information asymmetry. Heterogeneous products or non-standardized products and services also increase the uncertainty about the truthfulness of the buyer or seller. For example, the chance that a product may have some contaminations not stated in the contract. Market actors incur cost to protect themselves, such as wanting to be able to return products when they do not meet criteria as originally agreed upon.

Uncertainty

Internal or behavioral uncertainty refers to the difficulties in predicting the actions of market actors after a deal is reached (Williamson, 1985). It involves the risk assessment of the chance that buyers and suppliers will behave opportunistically after a deal is reached (Barthelemy & Quelin, 2000). Market actors engaging in transactions are not able to anticipate all possible complications and risks, as well as the required and delivered performance of each party. To reduce the risk of opportunism, market actors will try to put protective measures in place, thereby increasing transaction costs. Certain markets have many quality differences across products, which can increase the uncertainty among market actors. A greater uncertainty may make a market transaction more expensive.

Frequency

Frequency of transaction relates to the recurrence of similar transactions (Williamson, 1985). Opportunistic behavior becomes a problem when there are only a small number of market participants and transactions occurring. A high frequency of transactions creates incentives for sellers not to behave opportunistically since it may hurt their reputation. Having less frequent transactions reduces the alternatives for buyers so sellers may worry less about jeopardizing their reputation. A low frequency could therefore increase inspection costs of buyers, who need to check the quality of the products up for sale. Opportunistic behavior and the likelihood of moral hazard can become a problem when there are only a small number of market participants and transactions (Akerlof, 2001).

Asset specificity

The specificity of an asset exchanged or in some way employed in a transaction refers to “the degree to which an asset can be redeployed to alternative uses and by alternative users without sacrifice of productive value” (Williamson, 1991, p.281). Outside the specific transaction, durable, transaction-specific assets lose most of their value. Transactions have a high level of asset specificity when inter-organizational exchanges need to be supplemented by specific assets. If the transaction involves more specific assets to execute a transaction (thus increasing asset specificity), firms become more dependent upon their trading partner (bilateral dependency) or become locked in a relationship due to the nonredeployability of the assets (Williamson, 1981). For example, market actors who want to discontinue a relationship will reduce the value of these specific assets and incur so-called “switching costs.” (Klemperer, 1995; Monteverde & Teece, 1982). Williamson (1991, p. 282) argues that “asset specificity increases the transaction costs of all forms of governance.”

There are several forms of asset specificity, such as site, product, human capital (Williamson, 1991). Site specificity refers to economic advantages unique to specific geographical locations. For example, Toyota required suppliers in Japan to locate within close proximity to improve reliability of supply and reduce inventory costs. Product specificity, also referred to as technical or physical specificity, includes specialized equipment that can only be used within a specific relationship to produce specific made-to-order parts. Human capital specificity refers to learning by doing and the development

of human skills and knowledge that are needed to transact with a specific market actor (Stuckey & White, 1993; Williamson, 1991).

2.3.3. Atmosphere

Williamson argues that transactions take place within a “trading atmosphere” (Williamson, 1975, p.37)⁹, which may reduce opportunism (Gander & Rieple, 2004). A trading atmosphere refers to the “quasimoral involvement among the parties” (Williamson, 1975, p.38-40), reciprocity and the non-pecuniary satisfaction of a specific governance structure (Sanghera, 2004). Atmosphere can, for example, influence the preference of market participants for a particular governance mechanism through which transactions occur (e.g., people may value being self-employed instead of working for a firm) (Douma & Schreuder, 1991, p.128; Williamson, 1975, p.37). Other scholars have pointed out that atmosphere influences inter-organizational exchange (Gander & Rieple, 2004; Ivens & Blois, 2004; Joshi & Stump, 1999). Since atmosphere influences the human and environmental factors it therefore also affects the nature of transactions, as well as the choice of a governance structure (Williamson, 1975, p.37).

2.3.4. Governance structures

Williamson (1981) uses transactions as a basic unit to understand governance structures, referring to ways of coordinating economic activity. He argues that transaction cost economics measures the comparative efficiency of transactions in performing a process

⁹ “A more satisfying trading atmosphere sometimes obtains” (Williamson, 1975, p.40).

within a firm, as opposed to sourcing the process out to the market (Williamson, 1975). Markets and organizations are the two ideal types of coordination mechanisms. A comparison of the costs to “plan, adapt and monitor the completion of transactions under alternative governance structures” provides an understanding of why transactions are executed by a particular form of coordination (Williamson, 1981, p. 7). The economic costs can be decomposed into transaction costs and production costs¹⁰ (Wallis & North, 1986, p. 97). The governance structure, which can minimize the sum of the production and transaction costs, will be the preferred choice to coordinate economic activity (Douma & Schreuder, 1998, p. 141).

Higher levels of asset specificity, greater uncertainty/complexity, and lower frequency of transactions will result in relatively higher costs to execute a transaction across a market (Douma & Schreuder, 1998, p. 147). In such situations, hierarchies would be preferred over markets, since an organization (a form of hierarchy) can act as a substitute for a market by economizing on transaction cost. For example, organizations may decide to produce goods or services in-house by vertically integrating with other firms. In-house production may reduce information problems and opportunistic behavior due to and knowledge within a firm, as well as increase the possibility to control and manipulate the transaction process (Casadesus-Masanell & Spulber, 2002; Klein, Crawford, & Alchian, 1978).

¹⁰ Production costs are “the costs of transforming inputs into outputs or the direct production expenses” (Wallis & North, 1986, p. 97).

2.3.5. Transaction costs

Transaction costs are those costs associated with the conduct of inter-organizational exchange. Elsewhere, transaction costs have been defined as “the costs associated with the transfer, capture, and protection of rights” (Barzel, 1997). Additionally, North incorporates the costs of measuring the product or service attributes with the costs associated with the transfer, protection and enforcement of an agreement and ownership rights (North, 1990). Finally, Kenneth Arrow defines transaction costs as “the costs of running the economic system” (Arrow, 1974).

Variations in transaction attributes may require different efforts to protect market actors against opportunist behavior, which may lead to variations in transaction costs. These variations influence the choice of governance or coordination through a firm or hierarchy (Douma & Schreuder, 1991, p.147; Williamson, 1975). Transaction costs economics does not assume a market of perfect information, but instead assumes that market information is costly to produce, transmit and obtain, a fact which may result in an unequal distribution of information among market actors (Alchian & Demsetz, 1972; Stigler, 1961). Specialization necessitates the costs of coordinating economic decisions across hierarchies and markets (Douma & Schreuder, 1991; Gurbaxani & Whang, 1991). Transaction costs are “the costs of running the economic system” (Arrow, 1974); for example, the cost of negotiating a deal to collect and distribute information about products to be exchanged (Barzel, 2002). Transaction costs are also narrowly defined as the costs associated with the transfer, protection and enforcement of ownership rights, in

addition to the costs of measuring the product or service attributes (Barzel, 1997; North, 1990).

Transaction costs can be categorized in two groups, namely coordination costs (*ex ante*) and the cost to safeguard a transaction¹¹ (*ex post*) (Johnstone, 2003; Milgrom & Roberts, 1992, p. 29; Sawyer, Crowston, Wigand, & Allbritton, 2003; Tether & Hipp, 2002).

Coordination costs

Coordination costs result from the need to coordinate actions between market actors, and from the activities and efforts leading up to an agreement. Coordination is defined as “managing dependencies between activities” (Malone & Crowston, 1994), and bringing different functions or activities into common or harmonic action, movement, or condition so they can function effectively (Merriam-Webster Inc., 1995). Coordination costs are defined as those costs “related to the need to determine prices and other details of the transaction, to make the existence and location of potential buyers and sellers known to one another, and to bring the buyers and sellers together to transact.” (Milgrom and Roberts, 1992 p. 28). Coordination costs include the costs to obtain information (Stigler, 1961), the costs of coordinating production inputs (Alchian & Demsetz, 1972), and the costs associated with measurement (Barzel, 1982). Coordination costs are grouped into the following categories:

¹¹ Safeguarding costs are sometimes referred to as motivation costs.

Costs to determine product offerings (Bakos, 1998). Sellers want to offer the product characteristics, which will maximize their profits. To determine the required production inputs, sellers need to gain information about the demand of buyers, costs of inputs, and availability of technologies (Bakos, 1998).

Search costs (Lucking-Reiley & Spulber, 2000; Tether & Hipp, 2002) are “the costs of locating information about opportunities for exchange” (North & Thomas, 1973, p. 93). They include a) costs resulting from the search for information (Sawyer et al., 2003), b) the time to search for products, sellers, buyers and prices, c) the comparison of different products, buyers and sellers and d) the search for alternatives in new markets (Sandulli, 2003).

Inspection costs. These costs are the result of the assessment of the quality and suitability of goods before the actual transaction is completed and a price is negotiated. Inspection costs include the costs of a) ordering samples of goods or trying services, b) gathering information about every unit or a sample of units, c) assessing the quality of a set of product attributes (Barzel, 2002) and d) securing a minimal level of accuracy of information for which market actors feel comfortable with (Barzel, 2002). A large number of market actors may potentially reduce the inspection costs due to the role of reputation (Douma & Schreuder, 1991, p. 128).

Price discovery costs (Bakos, 1998). Market participants need to perform actions to determine an appropriate price for a transaction. For example, a seller may contact multiple buyers to solicit price quotes to determine the fair market price. Firms may also consult prices on commodity exchanges or other industry price indexes.

Negotiation costs (Coase, 1937; Tether & Hipp, 2002). Negotiation costs are defined as “the costs of negotiating the terms of the exchange” (North & Thomas, 1973, p. 93). The costs associated with negotiation, contracting and bargaining arise from “negotiating and completing separate contracts for each market transaction” (Coase, 1937). Markets of heterogeneous products make each transaction more unique, requiring market participants to devote more resources to the negotiation of the specific product features, quality, and price; other product or service attributes include such terms and conditions as delivery vs. pick up and payment method (e.g., cash or credit).

Administrative costs. These costs result from the actual execution of the transaction. Examples include the costs of filling and getting permit requirements and the costs of formulating a contract (Johnstone, 2003; Sawyer et al., 2003; Tether & Hipp, 2002).

Safeguarding costs

Safeguarding costs are also referred to as motivation or vulnerability costs (Milgrom & Roberts, 1992). Safeguarding costs are the costs market actors incur to protect themselves against opportunistic behavior of the trading partner and other vulnerabilities after an agreement (*ex post*) is reached; consider cheating and deception (Mathiesen, 1997; Williamson, 1985). Opportunistic behavior can be the result of information incompleteness or asymmetries, occurring when “a buyer or seller may not possess sufficient information to monitor whether a contract is acceptable and whether the terms of a contract are being met” and imperfect commitment between parties, when “a buyer or seller wants to cancel a contract or is unable to meet the current specifications of the agreement” (Milgrom & Roberts, 1992; Sandulli, 2003). Motivation costs can be categorized as follows:

Monitoring costs. The result of the efforts by market actors to check quality, quantity, and prices of purchased products, reaching deadlines, while maintaining secrecy (Sawyer et al., 2003). Other examples are the costs of control measures and the costs to obtain referrals of the transaction party from other market actors.

Enforcement costs. The costs of enforcing a contract arise if a trading partner does not live up to a previous agreement (North & Thomas, 1973, p. 93). The other party may have to take legal action to force the other party to stick to the initial agreement.

Adaptation costs: These costs arise from changing the initial agreement (Sawyer et al., 2003), which may, for example, result from problems of quality and delivery.

Summary

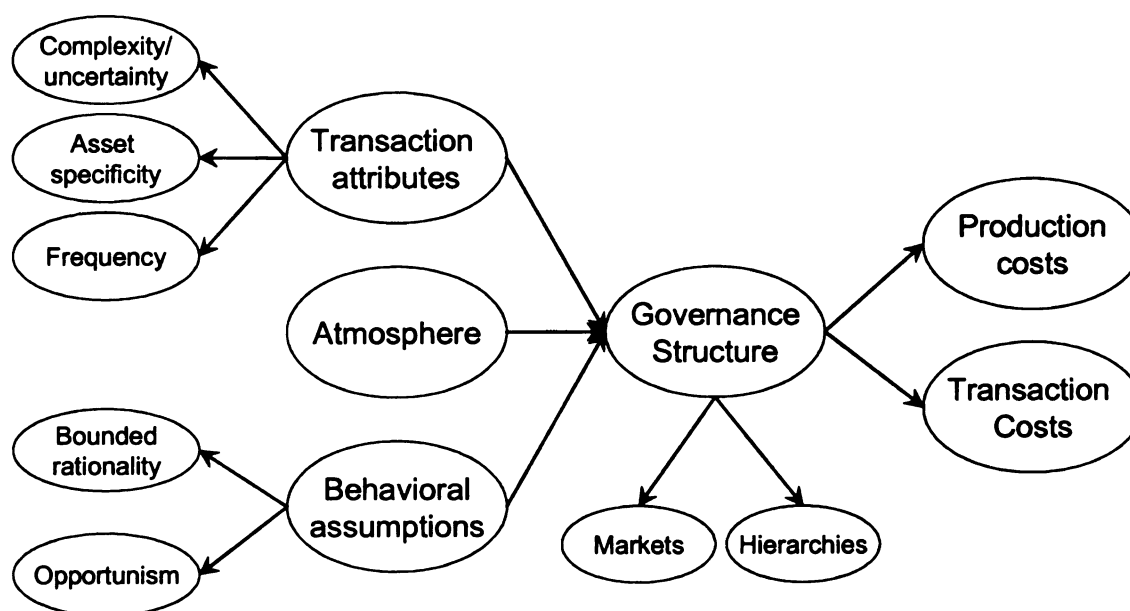
Transaction cost theory argues that the assumptions of the bounded rationality and opportunism of market actors, coupled with the three transaction attributes of frequency, complexity/uncertainty, and asset specificity, lead to transaction costs (Williamson, 1975). The choice of governance structure (markets or hierarchies) depends on the extent to which each specific coordination mechanism is able to reduce transaction and production costs associated with these attributes. Hierarchies have relatively high production costs (e.g., lack of competition) but relatively low transaction costs (e.g., reduced uncertainty). Markets have relatively lower costs of in-house production in comparison to buying products on the market due to increased competition, but relatively high transaction costs (e.g., incurred cost to reduce uncertainty about the quality of products) (Table 1). Atmosphere may complicate the choice of governance structure as shown in Figure 2.

Table 1: Relative economic costs for markets and hierarchies

Governance structure	Production costs	Coordination costs
Markets	<i>Low</i>	<i>High</i>
Hierarchies	<i>High</i>	<i>Low</i>

Source: (Malone et al., 1987; Williamson, 1975)

Figure 2: Logic TCT



Source: Inspired by Williamson, 1975, 1985.

2.4. Use and effects of electronic markets

The work of Malone *et al*, 1987, strongly influenced contemporary thinking and perceptions of the use and benefits of Internet tools or so-called electronic markets.¹² Malone *et al*. theoretically based their analyses and predictions upon the application of transaction cost economies to the use and effects of Internet tools.¹³ Malone *et al*, 1987, defined the Electronic Market Hypothesis (EMH). Many argued that Internet tools would facilitate communication, brokerage, and integration, thereby reducing the costs of market transactions (Bakos, 1998; Choudhury, Hartzel, & Konsynski, 1998; Kaplan & Sawhney, 2000; Malone et al., 1987; Rabinovich, Bailey, & Carter, 2003; Smith, 2002; Timmers, 1998). The reduction of transaction costs through the use of electronic markets may make it a more attractive governance structure for firms in favor of hierarchies (Malone et al., 1987). A reduction of transaction costs could increase the benefits from trade and associated social welfare.

¹² Electronic markets are a specific Internet tool. E-markets are defined as “an inter-organizational information system that brings multiple buyers and suppliers together, allows the participating actors to exchange information about prices and product offerings, and provides mechanisms that facilitate trade” (Bakos, 1991).

¹³ Malone *et al* originally referred to electronic markets which is here discussed as market-like Internet tools.

Communication effect

The communication capabilities of Internet tools such as email enable market actors to exchange and process more information while at the same time reducing the costs of communication; this is referred to as “the communication effect” (Malone et al., 1987). Multiple studies have found evidence supporting this idea (Bakos, 1991, 1997). Internet tools can be used to support and enhance existing trading activities, enabling faster and more comprehensive communications; for example, sending a written description and picture of a product electronically instead of via regular mail. As a result, firms can increase their productivity and trading volume, without necessarily expanding the number of salespersons (Brynjolfsson & Hitt, 1996; Buckley et al., 2000).

Brokerage effect

The brokerage capabilities of Internet tools like Web-based auctions can facilitate the aggregation and matching (search and selection) aspects of supply and demand, as well as introduce price discovery mechanisms; this is referred to as the brokerage effect. For example, online brokers can enable the consolidation of supply and demand, reducing the costs associated with the search and evaluation of the necessary information to transact (e.g., identification and selection of a specific trading partner and products). Online brokers can setup electronic databases to enable aggregation of product offerings, which can increase the number of choices and quality of alternatives (products and market participants) offered to both buyers and sellers (Bakos, 1998; Malone et al., 1987). Online aggregation may therefore result in easier and less costly selection of trading partners and price comparisons (Choudhury et al., 1998; Son & Benbasat, 2004).

Web-based auctions may further automate the determination of prices between buyers and sellers; they may thereby reduce coordination costs. Online auctions enable sellers to interact with a much larger number of buyers in comparison to conventional solicitation price quotes and negotiations of prices. The benefit may be a reduction of the time needed to determine the price of a good or service. Market actors may prefer online brokers (thus intermediaries) to conduct a market transaction since they reduce coordination costs associated with uncertainty and opportunism¹⁴.

Integration effect

Electronic interconnections offered by Internet tools may enable buyers and suppliers to integrate their business processes more effectively, which can reduce inventory and ordering costs; this is hereafter referred to as the integration effect. For example, electronic integration can enable buyers and sellers to link their inventory systems together to provide more up-to-date information about current and future demand. As a result, the uncertainty about demand can be reduced and production planning can be improved.

¹⁴ Buyers and sellers will incur transaction costs in the form of commissions paid to online brokers.

2.4.1. Prediction of the move to e-markets

The use of communication, brokerage and integration capabilities of Internet tools enables firms to economize on costs of market transactions, “leading to overall transition toward proportionately more use of (electronic) markets rather than hierarchies (organizational structures such as firms) to coordinate economic activity” (Malone et al., 1987). Malone *et al* provide two main arguments for the move from non-electronic hierarchies and non-electronic markets towards electronic markets (see Figure 3).

First, Internet tools reduce the unit costs of market transactions (e.g., outsourcing) in comparison to in-house production. Internet tools or electronic markets would reduce transaction costs and would favor the buying of products on an electronic market instead of production in hierarchies such as in-house production (Bakos, 1998; Choudhury et al., 1998; Malone et al., 1987) and many others.

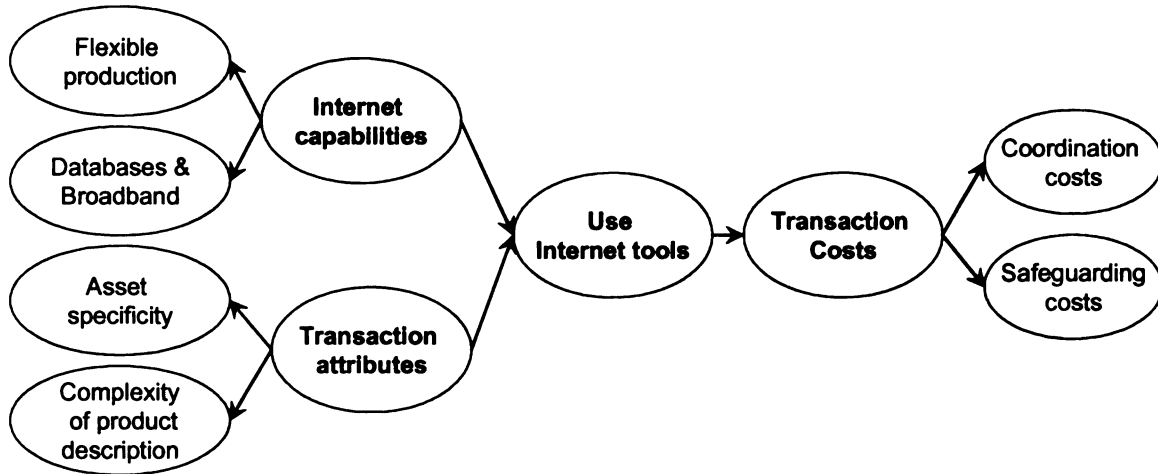
Second, the use of the three capabilities of Internet tools would fundamentally affect two transaction attributes, namely the complexity of product descriptions and asset specificity. The capabilities of Internet-based tools would reduce the complexity of product descriptions relative to information processing, as occurs when accessing product databases to assess the product quality, or when emailing a detailed description and blueprints. Communication and manipulation capabilities can thus reduce relative

product complexity and associated coordination and safeguarding costs¹⁵ (Garicano & Kaplan, 2000).

Finally, Internet tools are increasingly used to ameliorate the speed and accuracy of production, to enable the cost-effective manufacturing of differentiated products in small batches at the same machine or production line (Malone et al., 1987). As a result, firms can produce specific products without being tied to a specific buyer or supplier. In other words, the use of Internet tools increases switch-over capabilities, which reduces asset specificity (Malone et al., 1987). However, the example used by Malone *et al* to explain the effects of Internet tools on asset specificity is disputable. The example of a reduction of product specificity by Malone *et al* concerns flexible production, which is rather a production-related technology, which may indirectly affect transaction costs. Below, in the discussion of the framework, product specificity will be further addressed, in the context of recyclable materials.

¹⁵ Note: Malone *et al* referred to control costs instead of safeguarding costs.

Figure 3: Basic logic of transaction costs and use Internet tools



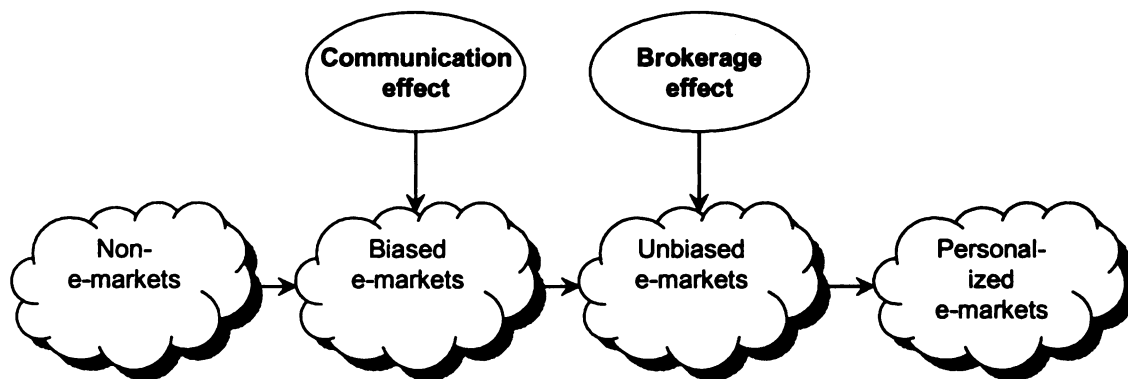
Source: Inspired by Malone *et al.*

2.4.2. Prediction evolutionary stages of e-markets

Studies on the use of Internet tools grounded in transaction cost theory recognized that technological capabilities of Internet tools continue to evolve (e.g., databases and broadband communications), and would therefore continue to reduce the relative complexity of product descriptions (e.g., sending pictures by email) (Clemons et al., 1993; Malone et al., 1987). Based on this observation, Malone *et al* predicted three evolutionary stages of e-markets which were more or less identified by others as well (Bakos, 1998; Dai & Kauffman, 2002; Timmers, 1998). First, the communication effect (e.g., improved communication) would trigger the emergence of biased e-markets at the cost of non-electronic hierarchies and markets. The reduction of transaction costs would be limited since the e-market is biased towards a single buyer. Biased markets may emerge that are characterized by multiple sellers who do business with a limited number

of large buyers (Kaplan & Sawhney, 2000). However, brokerage capabilities of Internet tools (e.g., Web-based auctions) would result in the emergence of unbiased e-markets (markets with multiple sellers and buyers and not biased towards a buyer or seller), resulting in a further reduction of transaction (and production) costs (see Figure 4). Eventually, personalized e-markets would emerge due to increased personal filtering capabilities of Internet tools. For example, software or rule-based agents could assess multiple information sources and could engage in much more complicated and detailed negotiations, which would further reduce the cost to assess the complexity of a product description.

Figure 4: Evolutionary stages electronic markets and the two effects



Source: Derived from Malone *et al.*

2.4.3. Critique of studies on electronic markets

Studies of electronic markets can be criticized along multiple dimensions, as discussed below.

Stages of electronic markets

The stages of electronic markets as defined by Malone *et al* and later adopted and modified by others¹⁶ (Christiaanse & Markus, 2002; Davenport & Cantrell, 2001) lack clear definitions and conceptual clarity. For example, Malone *et al* leave out the geographical dimensions of markets (e.g., regional, national or global markets), which could strongly influence the perception of market bias. Further, the dimensions provided by Malone *et al* (biased, unbiased, personalized) do not match with the definitions of market efficiency.¹⁷ Malone *et al* fail to address other dimensions of markets such as transparency, opaqueness, and market friction (Brynjolfsson & Smith, 2000). Further, personalized e-markets lack a clear linkage to a particular effect, and the integration effect does not have a direct relationship with any of the evolutionary stages of e-markets.

¹⁶ Commonly, e-markets are categorized as private, consortia-led or independent.

¹⁷ Although disputed, market efficiency is used in financial economics. Three forms of market efficiency are identified, namely weak (information on past prices), semi-strong (all public information related to a stock or product), and strong (public and private information related to a stock) (Ross et al., 2005).

Furthermore, the definitions of market types are not related to the specific ways to discover a price. For example, it is argued that the brokerage effect leads to unbiased e-markets. Auctions are a form of brokerage, but auctions can be biased or unbiased (Granados et al., 2005). Also, price discovery within certain industries, like the recycling industry, can be characterized as informal markets in which concurrent direct bilateral negotiations enable buyers to solicit and compare quotes from multiple sellers. It is difficult to fit such negotiations within the specific evolutionary stages of e-markets of Malone *et al.*

Integration effect

Malone *et al* argue that the integration effect may lead to e-markets as well as e-hierarchies. In fact, the logic of many examples of the integration effect seems to indicate that integration capabilities of Internet tools lead to electronic hierarchies instead of e-markets (Hess & Kemerer, 1994). Also, integration capabilities are not directly linked to a specific e-market evolutionary stage. The above discussion provides enough arguments to refrain from developing any propositions concerning the integration effect. Further, a direct test of the EMH would require extensive indications of the transactions occurring within hierarchies before and after the introduction of Internet tools. Such information requirements are unrealistic. One reason is that outsourcing is increasingly a global phenomenon and may involve multiple economic sectors. For example, the catering of food within a factory may be classified as manufacturing. The manufacturer may decide to buy the services on an e-market. Surprisingly, the catering of food is now classified as

a service industry, which would make it almost impossible for researchers to observe a proportional shift from hierarchies to markets within an industry.

Electronic market predictions

The theory behind the classification of e-markets seems underdeveloped and acts as a conceptual umbrella for the many different dimensions of markets. For example, it is difficult to apply the classification of e-markets to real-world inter-organizational exchange. Therefore, it would be conceptually difficult to identify different evolutionary stages of e-markets within different industries.

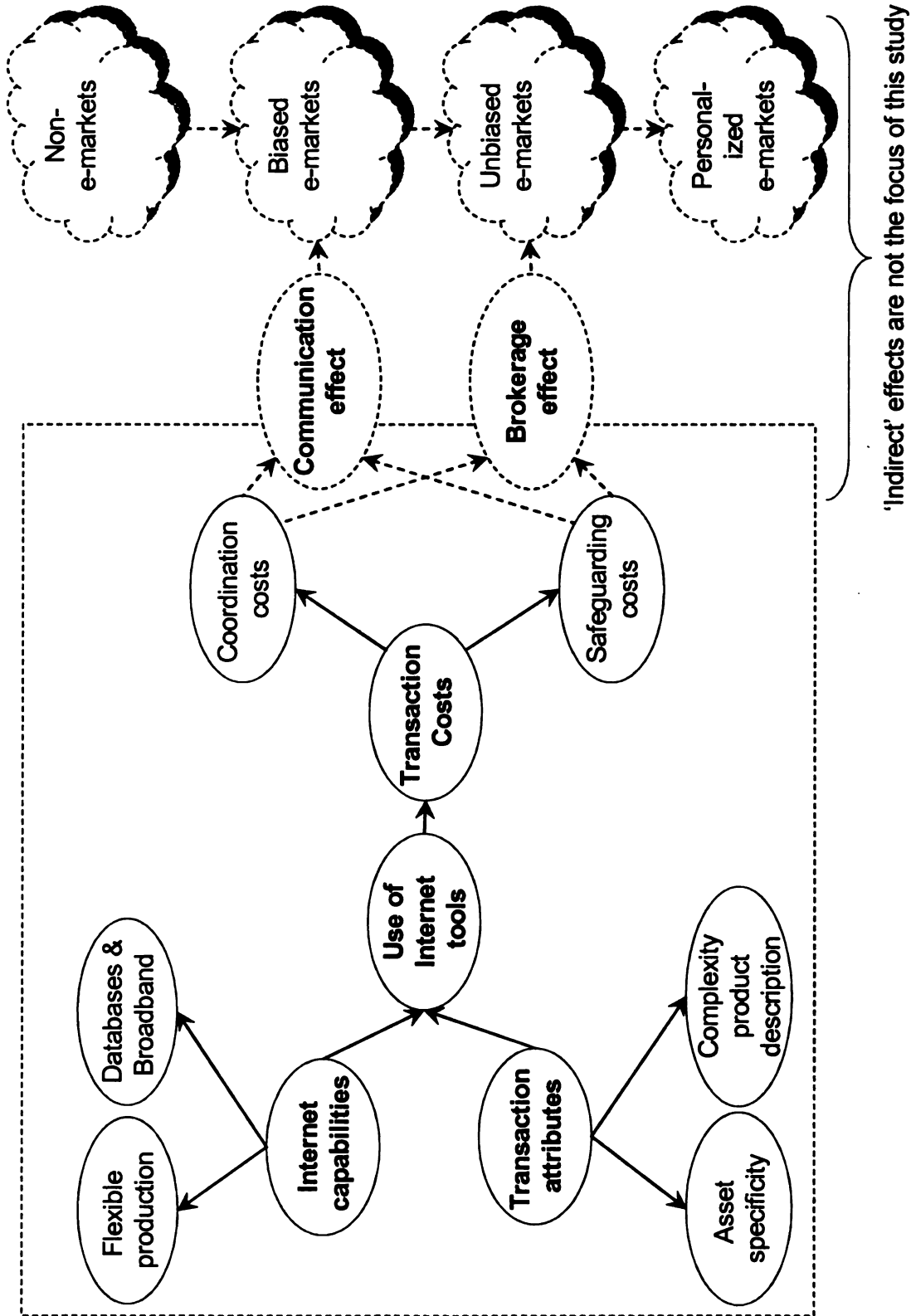
Focus on coordination costs and neglect of safeguarding costs

This study will focus on how the specific communication and brokerage capabilities of Internet tools lead to a reduction of coordination and safeguarding costs. The reduction of transaction costs says much for the use of Internet tools in communication and brokerage. Malone *et al* argue that the communication and brokerage capabilities of Internet tools lead to a reduction of coordination and safeguarding costs. However, Malone *et al* do not clearly differentiate between a specific effect and a reduction of coordination and safeguarding costs. In fact, many studies grounded in TCT focus predominantly on coordination costs, but tend to neglect safeguarding costs (Bakos, 1998; Malone et al., 1987). Such neglect may very well have biased the results, as problems with the use of Internet tools to reduce the costs associated with opportunistic behavior and bounded rationality were overlooked. For example, business relationships have traditionally enabled the reduction of safeguarding costs when firms were to engage in transactions.

Studies on the effects of e-markets suggest that brokerage-like Internet tools affect safeguarding costs associated with information asymmetries and imperfect commitment. For example, Clemons, Reddi and Row argue that IT reduces both coordination and safeguarding costs (referred to as transaction risk) (Clemons et al., 1993). Others argue that the use of Internet tools can both increase and decrease safeguarding costs, since firms may behave opportunistically by renegotiating a contract when some part of the deal is already made, such as the shipping of goods (Dewan & Hsu, 2004; Garcia-Dastugue & Lambert, 2003; Garicano & Kaplan, 2001). For example, IT makes it possible to improve the tracking of behavior of market actors, thereby reducing monitoring and commitment costs (Garicano & Kaplan, 2001). Also, the inability to physically inspect goods on an online auction may provide incentives to complete third-party inspection forms to reduce information asymmetry, in comparison to offline auctions who lack such reports (Dewan & Hsu, 2004; Garicano & Kaplan, 2001).

The identification of the relationships between communication and brokerage effects in relation to coordination and safeguarding costs could provide a greater understanding of the underlying assumptions of the uptake of electronic markets. The reduction of transaction costs through the two effects may foster the emergence of the two e-market forms. Therefore, the use of communication and brokerage-like Internet-based tools may result in two evolutionary stages of e-markets, namely biased and unbiased markets, but this, however, is not the focus of this study. Such an indication of evolutionary stages may provide a starting point to speculate about the observation of the EMH within an industry (Figure 5).

Figure 5: Effects of transaction costs on the evolution of e-markets



2.4.4. The recycling industry and the use of electronic markets

Relatively high costs of market coordination prevail in the recycling industry (Johnstone, 2003). High transaction costs form favorable conditions for emergence of electronic markets. The EMH would lead us to expect that firms in the recycling industry will have a great inclination to use Internet tools since it enables them to reduce transaction costs (Malone et al., 1987). Thus it is expected that we would observe a relatively high use of Internet tools to reduce transaction costs.

Recycling is defined as the “reuse of material in a production process that diverts it from the waste stream” (Johnstone, 2003). Recycling materials are generated from producers (e.g., metal scrap from turnings) and end-consumers (e.g., appliances), which can not be re-used. The major industry value segments are generation, collection, processing, and consumption (manufacturing). Recyclable material wholesalers are firms, which perform the processing such as the sorting, aggregation and densification of recyclable materials. Recyclable material wholesalers sell their materials to consumers such as steel mills, foundries, and paper mills. Recyclable materials wholesalers may trade fully-processed, semi-processed, and unprocessed materials to consumers in the US and abroad. In the United States, processing and consumption are the two largest segments in the recycling industry in terms of employment and turnover (Beck, 2001). The major product markets for recyclable materials are ferrous and non-ferrous metals, paper, and plastics (Beck, 2001).

Recyclable material wholesalers are confronted with several challenges. The challenges have led to a range of non-environmental related market coordination problems and thus relatively high transaction costs of doing business in the recycling market (Tether & Hipp, 2002; Thierry, Salomon, Van Nunen, & Van Wassenhove, 1995). Relatively high transaction costs may reduce the benefits from trade. The major challenges are related to the following issues:

Quality and content. Firms incur transaction costs related to the assessment of the often heterogeneous and varying quality and content of recyclable materials. For example, heterogeneous recyclable materials increase the costs associated with the complexity of product descriptions. Also, the uncertainty about the capability of buyers to handle specific materials increases the costs for sellers to search and select buyers and to negotiate a deal. Recycling firms incur coordination and safeguarding costs to reduce their uncertainty. Further, market actors are vulnerable due to the varying and heterogeneous quality and content of recyclable materials. For example, when materials do not meet the specifications of the purchase order, buyers may decide to reject a shipment or downgrade the price of the materials, a process which is costly for both buyer and seller. Due to the uncertainty related to the quality and content, buyers and sellers incur negotiation, monitoring, enforcement and adaptation costs.

Product value uncertainty (Johnstone, 2003). Recyclable materials or commodities are confronted with great price volatility (IRS). Price volatility is an

indication of the uncertainty about the value of recyclable materials. Uncertainty of the value of products increases the costs of price discovery. Such costs may increase when firms sell certain materials infrequently. The uncertainty about the value of products might increase from firms lacking an awareness and/or understanding of how they may use recyclable materials in their production processes (Johnstone, 2003). For example, certain recyclable materials may have a content or quality that is out of the ordinary and complex to explain. Therefore, a seller may need to put more effort in activities explaining the value of the material to the buyer. As a result, the market actors may incur costs associated with the determination of product offerings, search and inspection.

Demand uncertainty (Thierry et al., 1995). Demand for recyclable materials is dependent on the rapid and frequent fluctuations of prices of primary commodities (e.g., iron ore) and consumer end-products (e.g., sheet metal). For example, when prices of iron ore are relatively high, steel mills are inclined to substitute portions of their feedstock with recyclable materials due to the price advantage. Also, consumers may need materials at short notice, perhaps because a deal fell through with an existing supplier. Demand uncertainty increases the costs to determine product offerings and to search for suitable buyers.

Value-to-weight ratio and its effect on international and regional markets.

The generation or ‘production’ of recyclable materials is local and dispersed geographically. Aggregation therefore occurs at the local level, which is one of

the reasons that the recycling market consists of many small and medium-sized players. Further, recyclable materials have a relatively low value-to-weight ratio. As a result, shipping costs make up a relatively large portion of the total costs of doing business in the recycling industry. Due to differences in value-to-weight ratio recyclable materials differ in the degree to which they can be shipped over geographical distances. For example, non-ferrous metals have a relatively high value-to-weight ratio, which increases export opportunities. The differences in value-to-weight ratios of recyclable materials lead to relatively high search costs, since sellers need to determine the geographical range in which interested buyers may be located for each sale. Varying geographical range also increases negotiation and monitoring cost, since buyers may only be contacted infrequently. Moreover, buyers located further away may be more uncertain about the capabilities of potential buyers (e.g., financial standing and requirements concerning material specifications and packaging) and in this way increase transaction costs.

Capabilities and routines (Johnstone, 2003). Organizations must learn how to integrate recycled materials into their existing production processes. In addition, recyclable material wholesalers need to learn how to best process customized materials for specific buyers. However, customization increases product specificity. As a result, a seller may incur higher negotiation, contracting, monitoring, enforcement and adaptation costs to protect himself against potential strategic behavior of the buyer.

2.4.5. Recyclable materials and transaction attributes

It is argued that Internet tools reduce transaction costs (Bakos, 1997; Kaplan & Sawhney, 2000; Malone et al., 1987). Internet tools are therefore expected to improve business processes, and offer a solution in situations where markets have a difficult time emerging. The nature of transaction attributes and the relatively high transaction costs associated to the trade of recyclable materials provide 'favorable' theoretical conditions for a relatively high use of communication and brokerage-like Internet tools (e.g., Web-based auctions) within the recycling industry. Furthermore, the success of business-to-consumer e-markets for second-hand goods (e.g., eBay) may provide an indication of a potential high use of B2B e-markets for recyclable materials, due to some similarities in the nature of products.

Transaction costs stem from the transaction attributes of complexity, uncertainty, asset specificity and frequency. It is argued by Malone *et al* that the antecedent of the use of Internet-based tools is found in two transaction attributes, namely complexity of product description, and product specificity. The logic is that firms confronted with relatively high transaction costs have an incentive or motive to use Internet tools since it can reduce these costs. As is expected, the relatively high complexity of product description and product specificity of recyclable materials results in high use of Internet tools in the recycling industry, reducing associated transaction costs.

Complexity of product description

Communication and brokerage-like tools can reduce the relatively high transaction costs stemming from the transaction attributes within the recycling industry. For example, the recycling industry is confronted with complex products due to a heterogeneity of quality and content. Complexity of product description makes it harder for firms to compare all firm and product characteristics of different market actors. Firms are expected to use communication and brokerage-like Internet tools. First, a greater information exchange facilitated by communication-like Internet tools may reduce the costs to buy or sell complex (hard-to-describe) products. Communication-like tools may also reduce the market costs and explain the value of specific materials. For example, email can be used to send a digital picture of materials up for sale. Digital representation capabilities of Internet tools may therefore reduce coordination and safeguarding costs. Second, brokerage-like Internet tools such as demand and supply aggregation websites bring together multiple offerings, which make it easier to search for products and sellers as well as to compare prices (Choudhury et al., 1998; Son & Benbasat, 2004).

Product specificity

The recycling industry is confronted with relatively high variability in quality and content. Consumers of recyclable materials may not be able to process certain varieties or certain contaminations (e.g., loose iron). Further, recyclable material wholesalers may customize materials for specific consumers, such as size of materials, or specific mix of materials. If material wholesalers prepare specific materials for a buyer, it increases the product specificity of the materials, inasmuch as the seller may not be able to find another

buyer for their materials if the buyer were to cancel the order. Thus, the seller has made specific investments to produce the materials.

The use of the Internet tools may reduce product specificity, since the seller may more easily find buyers for its customized materials, in case a deal falls through. Internet tools such as aggregation websites may be a way to find such buyers. Also, the seller may put the materials up for auction so it can find more suitable buyers, who may adjust their bids according to the need for processing and adjustment of materials to specifications.

2.5. *Industry-wide use of Internet tools*

Studies of Internet tools use grounded in transaction cost theory provided the fundamental logic of the cost reductive effects of Internet tools, which eventually translated into optimistic consultancy and academic reports during the dotcom bubble, which ended in March 2000 (Bygrave, Lange, Kotha, & Stock, 2001; Cassidy, 2002; Constantinides, 2004; Kotha, Rajgopal, & Rindova, 2001; Souitaris & Cohen, 2003). For example, Forrester Research predicted that Web-based auctions and exchanges would together trade goods and services for \$746 billion in 2004 (Katka, Temkin, & Wegner, 2000). Another consultancy report by Price Waterhouse Coopers (PWC) predicted that there would be 20,000 B2B markets operational in 2003 (Schlesinger, 2001), and that the Internet would be used for about 40 to 50 % of all transactions (Gebauer & Zagler, 2000). The predictions made in the late nineties by consultancy firms, press, academics, and Internet firms that “the Internet changes everything” (e.g., the way of doing business and to conduct trade) evaporated with the meltdown of Internet firm stocks (Jap & Mohr, 2002; Kauffman, Wang, & Miller, 2002).

Many B2B Internet auctions and aggregation websites were not able to attract any revenue or business activity (Kauffman et al., 2002; Lennstrand, Frey, & Johansen, 2001). Reports indicated that there was only room for 181 B2B e-markets by early 2004 (Schlesinger, 2001), since one or maybe two B2B e-markets would be able to handle all business conducted online within an industry (Latham, 2000). It was expected that only 20 % of the 600 B2B electronic markets would be able to avoid bankruptcy (Latham,

2000). A study of online B2B markets in eight industries found that over a two year period (2000-2002) only 43% of independent B2B exchanges were still in operation (Day, Fein, & Ruppertsberger, 2003). Within three years following the dotcom bust about 5,000 Internet companies closed down (Kauffman & Wang, 2003)¹⁸.

Current official data show that the use of Internet tools has become relatively small, but is still a substantive part of today's B2B trade. For example, the size of Internet tools in the industry of merchant wholesalers was more than \$272 billion in 2001. In that year, Internet tools account for 10.05% of total merchant wholesale trade, up from 8.05% in 1999¹⁹. The official statistics on the actual use of individual Internet tools is limited. Anecdotal information indicates some unexpected variations between the use of email, CFP/RFC, and Web-based auctions²⁰.

¹⁸ We should note that this study did not distinguish between B2C and B2B Internet firms.

¹⁹ In comparison, the total e-commerce sales in the retail industry were estimated at \$69.2 billion for 2004, or 1.9% of total sales (U.S.CensusBureau, 2005).

²⁰ The additional information provided by academic studies and consultancy reports should be regarded as indicative, since some reports have a clear sample bias.

2.5.1. Email

Email use dates back to 1965 and is used to compose, send and receive messages over the Internet (Wikipedia.com). In the 1980s, other email features were introduced such as file attachments, delivery confirmation, and Rich Text Format (RTF). The increase in broadband Internet connections made it possible to send any computer file along with an email, such as digital images, word documents, PDF files, spreadsheets, etc. Email messages can also be controlled for grammar and spelling or used together with translation software. Popular email programs include Microsoft Outlook/Express, or remote-access webmail like Yahoo! and Hotmail.

Multiple studies indicate that email is the Internet tool most widely-used by firms to initiate, manage and complete a transaction (Verhoest et al., 2003). Email is the jack-of-all-trades and is in effect the Swiss Army Knife of business people. It is used to distribute calls for proposals and quotes in firms such as Gartner Group, IDC and Forrester²¹. Also, email is used to confirm orders or arrangements made over the phone, to inform trading partners about changes in prices, availability, or production planning, and to coordinate actions such as sending out reminders of shipment dates.

²¹ Emarketer: eStats overview report, June 1998; Electronic Commerce in the Netherlands, IDC, 1998; Forrester report 'Resizing On-line Business Trade'; Forrester report 'Resizing On-line Business Trade 1998'.

The use of email by companies worldwide was about 98.5% in 2002, whereas in the same study it was found that 74.1% of the same companies had a company website and only 44.3% of the respondents used EDI²². A study performed in France, Germany, Italy and the UK revealed that email was used by most of the respondents (87.4%). In comparison, the Internet was used by 84.4% of companies, and EDI was used by 23.4% of the respondents (Verhoest et al., 2003). Worldwide corporate email traffic in 2004 was estimated to total 63.74 billion messages a day, exchanged between 543 million corporate mailboxes and 6.5 million wireless mailboxes (Radicati Group, 2005) .

Business people are increasingly making use of Internet-enabled handheld devices for email access on the road (Cieslak & Winkle, 2004; Economist, 2005b; Steinfield, 2004). Blackberries are the most popular Internet-enabled handheld device among business people with over 2.5 million users (Economist, 2005a). Blackberries feature so-called “push email,” so users do not have to check the mail server to check if they received any messages (Ammelrooy, 2005). The Blackberry is to business people “what Apple’s iPod music-player is to teenagers” (Economist, 2005a). The proliferation of unsolicited emails (spam) containing advertisements and viruses threat the use of email as a practical business tool. Reports estimated that spam messages already account for about two-thirds of all email traffic send in 2005 totaling 9.2 billion messages (Helm, 2005).

²² Center for Research on Information Technology and Organizations (CRITO), International Data Corporation (IDC), August 2002.

Theories explaining the use of electronic mail

Many studies on e-markets leave out the use of email as a tool supporting and facilitating electronic exchange. There are other theories beyond TCT to explain the use of email or choice of media in general, such as the theory on media or information richness (Daft & Lengel, 1986, 1984). The theory of media richness argues that communication tools differ in the way they can convey information and facilitate shared understanding (Rudy, 1996). For example, video conferencing has a high richness, whereas written emails have a low richness. It is argued that managers use Internet tools with enough richness to perform a specific tasks to minimizes uncertainty and costs of use (Daft & Lengel, 1986, 1984).

Media richness is also criticized, however, because it ignores the influence of social factors (e.g., the behavior of colleagues and organizational norms) on the selection and use of Internet tools, referred to as the social influence model (Fulk, Schmitz, & Steinfield, 1990). Furthermore, information richness is not capable of explaining the use of brokerage-like tools such as the matching of buyers and sellers. Also, media richness studies the use of Internet tools at the individual level, whereas this study's focus is at the level of industry, where other factors play a role, such as generally-accepted conventions regarding the use of email or other tools for specific communications, transactions and exchange. The social influence model and other industry-wide factors influencing the use of Internet tools are sufficiently discussed using factors derived from theories on the social and relational embeddedness of economic activity (see par. 2.6.5), as well as inter-organizational routines (see par. 2.6.7). The derived factors which may explain the variations in the use of Internet tools have the advantage of being able to be compared

across multiple Internet tools and their use, whereas media richness would only be relevant to the use of email.

2.5.2. Electronic Call for Proposals and Request for Quotes

Studies by ISM/Forrester show that about 70% of the companies used electronic CFPs/RPQs to solicit electronic offers at the end of 2003. We should be careful when interpreting these figures, since the study has a clear sample bias. It should be noted that CFPs/RPQs are often used concurrently with other Internet tools to perform and complete a business task. For example, CFPs or RFQs may be distributed by email, posted on websites of industry press, or announced on electronic marketplaces to their members. Subsequent bidding may occur through email or a bidding system (Turban, 2004).

2.5.3. Web-based auctions

Web-based auctions enable the efficient processing of bids from buyers or sellers. Despite the success of third-party owned consumer-to-consumer (C2C) and business-to-consumer open-bid auctions, such as those occurring on eBay.com²³, the use of third-party owned B2B Web-based auctions are in fact one of the least-used Internet tools applications. For example, an annual survey of ISM/Forrester showed that among the firms in their sample, more than 30% had used third-party electronic markets such as online demand and supply aggregation services (often referred to as electronic exchanges) and online auctions (ISM & Forrester, 2001-2003). The report does not indicate whether or not firms continued to use auction and online aggregators.

Official data from the US Census Bureau show that the share of third-party owned wholesale electronic markets (referring to establishments which do not take title on the goods and services traded) in 2002 was \$2.7 billion. This is only about 0.55% of total sales of that particular industry category (US Census, 2005), and about 1% of total Internet tools sales conducted within the merchant wholesale trade.

²³ It was predicted that C2C Internet auctions would have a turnover of \$52.6 billion by 2002 (Forrester Research, 1999).

2.5.4. Recycling industry

A confrontation of the assumptions with the observed patterns of the use of Internet tools could help explain the variations in use and effects. Therefore, we will take a closer look at a specific industry, namely the recycling industry. Surveys indicate a relatively low use of e-commerce by recycling material wholesalers. A survey performed in 2002 revealed that the industry segment 'Miscellaneous Durable Goods Wholesalers' (NAICS code 4219, 1997) which included 'Recyclable Material Wholesalers' (NAICS code 42193) ²⁴ had e-commerce sales accounting for 9.6% of total sales in 2001 and 2002 (U.S.CensusBureau, 2004a). This figure is lower in comparison to the average for the industry segment 'Durable Goods' (NAICS code 421), at 9.9% and 11.0% in 2001 and 2002, respectfully. These figures only provide a very limited view of e-commerce use by Recyclable Material Wholesalers, since its industry group Miscellaneous Durable Goods Wholesalers (NAICS code 4219, 1997) also includes other industries as well, such as 'Sporting and Recreational Goods and Supplies Wholesalers,' 'Toy and Hobby Goods and Supplies Wholesalers,' 'Jewelry, Watch, Precious Stone, and Precious Metal Wholesalers' and 'Other Miscellaneous Durable Goods Wholesalers'.

²⁴ The North American Industry Classification System (NAICS) in the United States has different levels of detail. The group Recyclable Material Wholesalers (NAICS code 42193) belong to the higher level group Miscellaneous Durable Goods Wholesalers with NAICS code 4219.

Additional data indicate that the recycling industry's use of Internet tools is below average in relation to all other industries. For example, the largest industry segment of the recycling industry is formed by buyers of recyclable materials situated in the primary metal manufacturing industry (Beck, 2001). E-commerce sales for the primary metal manufacturing industry as percent of total sales were 9.2% in 2002 and 2003 (U.S.CensusBureau, 2004a). In contrast, e-commerce sales for the whole US manufacturing industry, as percent of total sales, were 21.2% in 2003, up from 19.2% in 2002. Thus, e-commerce sales within the primary metal industry are far below the industry average in size and growth. The relatively low size of e-commerce sales conducted within the primary metal manufacturing industry gives an indication that a) consumers of recyclable materials do not purchases much scrap metal through Internet tools (e.g., Web-based auctions) and b) the sellers of recyclable materials may lack a large pool of active online buyers in the US.

2.5.5. Insufficient explanations and paradox

The data indicate industry-level variations regarding brokerage and communication-like Internet tools. The EMH framework does not provide a satisfactory explanation of the current level and type of Internet tools use. For example, the relatively low use of Internet tools within the recycling industry apparently contradicts EMH. Based on the relatively high transaction costs of the recycling industry we would expect firms to make a high use of Internet tools to reduce these costs. Further, there are indications that industries have a relatively high use of communication-like Internet tools (e.g., email) and the relatively low use of brokerage-like tools (e.g., Web-based auctions and demand/supply aggregation exchanges). The EMH would lead to the expectation of a relatively high use of brokerage-like tools, since it would enable firms to reduce transaction costs even further (Malone et al., 1987).

Previous studies tried to address some of the reasons of the failure of brokerage-like Internet tools, such as a low volume of completed transactions, a lack of customers, inability to attract sellers, lack of critical mass, technological challenges, economic and incentive conditions, etc. (Corsten & Hofstetter, 2001; Kambil & Heck, 1998). Studies indicate that many firms are critical of the use of brokerage-like tools such as auctions (Berryman & Heck, 2001; Huttenlocher, November 2001; Samuels, 2001). Many authors argue that auctions reduce coordination costs (Jap, 2002, 2003; Pinker, Seidmann, & Vakrat, 2003; Sashi & O'Leary, 2002). However, there is less agreement about the effects of auctions on safeguarding costs. Often, it is argued that the auctioneer or online

intermediary has to provide tools to reduce opportunistic behavior concerning non-contractible issues such as quality, integrity and trust (Klein & O'Keefe, 1998; Pavlou, 2002; Pinker et al., 2003) (Duh, Jamal, & Sunder, 2002). Many authors argue that Web-based auctions can circumvent this problem and thus accomplish a reduction of safeguarding costs due to the implementation of, for example, auction rules (e.g., access rules and mechanisms of price discovery), feedback mechanisms, pre-selection, etc. (Klein & O'Keefe, 1998; Sashi & O'Leary, 2002). However, it is still unclear whether the effects on coordination and/or safeguarding costs are the reasons why many firms perceive auctions as a threat and simply refuse to use them.

In contrast, many firms are still using one of the most basic and simple communication media, namely email, in place of more sophisticated and complex brokerage-like Internet tools, such as Web-based auctions. Empirical studies further indicate that email is used in B2B trade for many purposes, even though we would rather expect brokerage-like Internet tools (Humphrey, Mansell, Paré, & Schmitz, 2003; Pare, 2003). Interestingly, the use of email within inter-organizational exchanges is rarely studied, with only a few exceptions (Ketinger & Grover, 1997; Pare, 2003). Communication is needed for transactions, and firms have now replaced many traditional forms of communication with communication-like Internet tools to perform all sorts of activities. The reduction of coordination and safeguarding costs associated with inter-organizational exchange enables us to improve our understanding of the antecedents of the use of communication-like tools. However, communication-like Internet tools may be used for activities that may not necessarily involve transactions directly, so the effects of the use of Internet tools

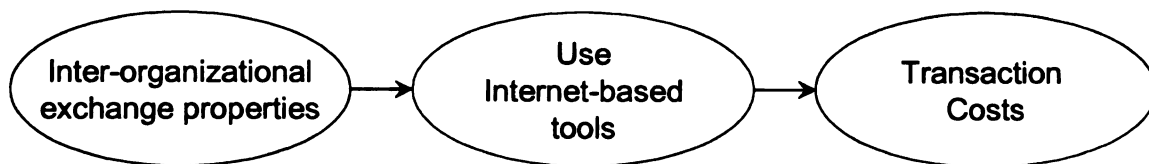
on transaction costs might be disputed. Though their effect may be indirect, faster and greater possibilities to communicate facilitated by communication-like Internet tools help to build informal relationships and trust that could increase the speed of inter-organizational exchanges, transactions, business processes and foster innovations (Muzzi & Kautz, 2003; Steinfield & Scupola-Hugger, 2005; Weber, Holmes, & Palmeri, 2005). As such, we argue that the theoretical framework underlying the EMH and other approaches on the use of electronic markets are suitable to understand antecedents of the use and effects of communication-like Internet tools.

Earlier we pointed out the methodological difficulties to test the EMH directly, due to the problems inherent in estimating all transactions occurring within markets and hierarchies before and after the introduction of e-markets. Still, these studies had problems to identify a move to electronic markets from hierarchies (Hess & Kemerer, 1994). Many studies focused instead on the use of individual brokerage-like B2B markets as an indication of the EMH and evolutionary stages of e-markets (Choudhury et al., 1998; Garicano & Kaplan, 2000). However, these types of studies often ignored communication-like Internet tools, which are also used to conduct trade online. Even the definition of the US Census Bureau of electronic commerce specifically mentions email. The previous discussion provides indications that the focus of prior studies on brokerage-like Internet tools, coupled with the neglect of communication-like Internet tools, may have led to an underestimation of the communication effect and an overestimation of the brokerage effect.

2.6. *Framework*

The antecedents derived only from transaction cost theory seemed unable to sufficiently and correctly explain the use and effects of Internet tools within industries. Many studies have combined the behavioral assumptions of transaction cost theory with other theoretical approaches, to enable further specification of the antecedents that explain the various uses and effects of Internet tools. However, these augmentations and specifications were only exploring specific additions, and were not previously presented in an integrated framework concerning inter-organizational exchange.

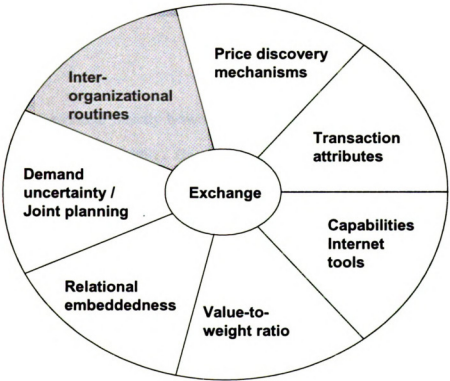
Figure 6: Basic framework



I propose a framework where so-called inter-organizational exchange properties precede the use of Internet tools. A specification of inter-organizational exchange properties is facilitated through an augmentation of antecedents derived from TCT, such as the assumptions on human behavior and characteristics of a transaction. Inter-organizational exchange properties (e.g., transaction attributes) are assumed to influence the use of Internet tools, which in turn affects transaction costs (Figure 6). This study ignores other effects (e.g., greater possibilities to differentiate products) for the sake of simplicity.

Specification of the inter-organizational exchange properties enables a greater understanding of the potential interdependencies among them. The discussion below explores the antecedents of the use and effects of Internet tools, namely price discovery mechanisms, transaction attributes, capabilities of Internet tools, value-to-weight ratio, demand uncertainty, relational embeddedness, and inter-organizational routines (Figure 7).

Figure 7: Inter-organizational exchange properties



2.6.1. Price discovery mechanisms

Market participants can select from three basic price discovery mechanisms to arrive at a price to transact, namely posted price, auctions or negotiations (Pinker et al., 2003). First, a posted price is an announced, fixed value, indicating at what price a market participant is willing to buy or sell a good or service. Posted prices reduce uncertainty, since a transaction can take place at the announced price. Second, an auction displays prices in a dynamic fashion, and is often used to exchange livestock, flowers, artwork, second-hand goods, and real-estate. Reverse and forward auctions are the major varieties of auctions. For example, the winning bid in a reverse auction is the lowest bid (Bichler et al., 2002). Forward or English auctions are characterized by bid increments where the highest bid is the winning bid.

Third, negotiations occur directly between buyers and sellers to reach a specific price (Giaglis, Klein, & O'Keefe, 2002). One-on-one negotiations are interactions between a single buyer and seller. One-to-many negotiations refer to situations when a seller is negotiating concurrently with multiple buyers individually (Dobler & Burt, 1996). Sellers may contact a series of potential buyers to get a better feeling for the demand for a particular product. Negotiations can be facilitated by a Request for Quotation (RFQ) or a Request for Proposals (CFP), which enable buyers and sellers to solicit (price) quotations or proposals for specific materials (Dobler & Burt, 1996)²⁵. A RFQ/ CFP may include the specifications of the quantity, quality and content of materials. Market actors may

²⁵ http://www.railmarketplace.com/inc/help/hosting/4.1_hosting_RFQ.pdf

negotiate other aspects of a deal later, such as delivery times, transportation mode, F.O.B. point²⁶, payment terms and conditions, performance standards and liability for claims and damage (Dobler & Burt, 1996).

Price discovery process

A price discovery mechanism sets explicit and implicit rules for the price discovery process. Price discovery is “the process through which buyers and sellers disclose their intentions expressed in monetary values”²⁷, and “arrive at a transaction price for a given quality and quantity of a product at a given time and place” (Schroeder, Ward, Mintert, & Peel, 1997). “Demand and supply ‘clear’ and trade occurs” when buyers and sellers agree upon the price and the terms and conditions of a contract (Bakos, 1998). Efforts to discover a price for a product are referred to as price discovery costs.

Trading system

A trading system is the specific application of a price discovery mechanism. The managers of a trading system (e.g., broker or auctioneer) can vary the rules of, for example, auctions, such as specified quantity, closing or opening bid, bid increment, reserve price, etc. eBay and Yahoo! Auctions are examples of different trading systems or

²⁶ Free-on-board (F.O.B.) is a designation of the place where title and control pass to the buyer, for example the loading materials on a transportation vehicle at the scrap yard of the seller (AMA, 2004).

²⁷ http://www.investorwords.com/3809/price_discovery.html

platforms. Although both platforms may have their specific rules and regulations, both systems rely on the same price discovery mechanisms, namely auctions.

Static comparative analyses of price discovery mechanisms

Transaction cost theory is often used in analyses to determine the efficiency and effectiveness of the different price discovery mechanisms within an industry (Canfax, 2003). These comparative studies aim to provide a theoretical and objective basis for the selection and preferred choice of one of the three price discovery mechanisms (Spulber, 1998; Tallroth, 2003). However, they often adopt an isolated and atomistic view of transactions (Adant & Gaspart, 2001; Kurov & Lasser, 2004; Purcell, 1997; Quan, 2002). Further, these studies focus predominantly on formal markets, such as cattle markets, financial markets and commodity exchanges. The availability of large sets of data enable researchers to focus on multiple indicators of efficiency, such as prices, price uncertainty, transaction costs, swinging supply and demand, transparency, liquidity, etc. (Capps, Love, Williams, & Adams, 1999; Pinker et al., 2003; Purcell, 1997). Comparative analyses often conclude that auctions are the most efficient price discovery mechanism, being in favor of posted price and negotiations (Canfax, 2003; Madhavan & Panchapagesan, 2002; Martens, 1998; Pinker et al., 2003; Purcell, 1997; Wang, 1993).

2.6.2. Transaction attributes

Below transaction attributes are discussed in the context of price discovery mechanisms.

Price uncertainty and negotiations in the recycling industry

The market for recyclable materials is characterized by a relatively high uncertainty about the market price due to the opaque market (Interview UG)²⁸ and heterogeneity of products and services (Interviews GA, PA-PE, CA, CB). Public price data of commodity exchanges of primary metals provide an indication for buyers and sellers as to the underlying fundamentals of the value of recyclable metals. A seller may also have private information on similar past transactions. Sellers solicit price quotes from buyers to gain more information about the current market price for a specific quality and quantity of recyclable material, to assess the willingness to pay and interest of a particular buyer, often referred to as whether a buyer is “hot” or not (Interview Q-1). Negotiations also allow sellers to evaluate other aspects of exchange, such as differences in quality, delivery schedules, financial standing, and flexibility in the comparison of quoted prices.

Interestingly, many studies on the antecedents and use of Internet tools leave out transaction attribute uncertainty. This study incorporates the uncertainty about prices as an antecedent of the use of Internet tools, since it may reduce the costs associated with

²⁸ Reference are made in this chapter to the exploratory case studies which provided input for performing the confirmatory case studies. Please see section 3.2. for more information.

price discovery, which is highly relevance for the recycling industry (Johnstone, 2003) (see paragraph 2.5). It is often argued that the introduction of brokerage-like Internet tools may reduce price discovery costs and improve market allocation (Bakos, 1998; Jap, 2003). However, this study additionally assumes that communication-like Internet tools may also reduce the cost of price discovery, as shown below:

Brokerage-like Internet tools. Sellers may also use brokerage-like Internet tools, such as Web-based auctions, when they are uncertain about the product prices and/or demand for certain materials. Auctions reduce the cost of price discovery, such as interaction costs associated with the need for soliciting multiple buyers. Also, auctions enable sellers to reach more potential buyers, in comparison to concurrent negotiations. This increases the likelihood that auctions may produce favorable results for sellers when demand exceeds supply (Bichler et al., 2002). Also, auctions reduce the cost of finding out who is hot or not, as well as costs associated with social pressure from preferred partners to provide ‘favorable’ prices.

Communication-like Internet tools. For example, communication-like tools such as email enable easier and enhanced exchange of information about the quality and content of the materials, which reduces the cost of estimating the price of materials. Also, online real-time price data services, which provide greater and low-cost access to up-to-date market information about major commodity exchanges, can reduce price discovery costs associated with price uncertainty.

Based on the previous discussion, the following proposition is derived:

Proposition 1a: The use of communication and brokerage-like Internet tools reduces coordination costs associated with price uncertainty.

Brokerage-like Internet tools and the introduction of price discovery mechanisms

The EMH predicts that exchanges will evolve to brokerage-like e-markets. However, Malone *et al* fail to recognize that the use of brokerage-like Internet tools may imply the introduction of a price discovery mechanism not previously employed within an industry value segment. For example, recyclable material wholesalers might be accustomed to doing business and exchanging materials through bilateral concurrent negotiations, rather than using auctions. The EMH may therefore imply a replacement of the industry-wide use of negotiations, through the use of brokerage-like Internet tools such as Web-based auctions.

Strikingly, an industry-wide transition from one price discovery mechanism to another and it's the associated negative effect on business relationships has rarely been studied²⁹ (Grover & Ramanlal, 1999). For example, auctions need relatively greater number of

²⁹ There are many studies on the use, implementation and effects on the level of the individual firm (Markus, 1994, 2004), and dyad to lesser extend. However, rarely studied are the dynamics on an industry level, with a few notable exceptions (Wigand, Steinfield, & Markus, 2005).

buyers and sellers to secure liquidity). In addition, comparative analyses of transaction costs, for the most part, do not address the cost of transition or evolution from one mechanism to another. These transition costs may reduce the benefits derived from the use of Internet tools, thereby reducing the motivation to use them in the first place. Transition costs associated with the implicit substitution of a price discovery mechanism may explain the criticism of market actors of auctions, as well as their subsequent lack of use. For example, reverse auctions are perceived as a way to squeeze sellers to a potentially unsustainable level of prices (Dobler & Burt, 1996, p. 251).

Product specificity

Unexpected quality differences (e.g., undetected contaminations of recyclable materials) may lead to complaints of buyers and result in costly rejections or downgrades of the materials. Consumers (buyers) may not be able to handle such contaminations, since they may require them to sort the materials further. However, brokerage-like tools such as Web-based auctions seem to be unable to resolve these issues informally and quickly. This observation is in contradiction with the statements of other researchers, who often argue that brokerage-like Internet tools reduce product specificity (Choudhury et al., 1998; Malone et al., 1987). Moreover, sellers may be confronted with winning bidders who they do not know. Such buyers may not follow through with their commitments, such as payment and pickup of the materials. What is worse, however, is that buyers may start complaining about the specific types of materials, which may result in costly rejections and downgrades. Thus, auctions may reduce coordination costs (namely price

discovery costs), but at the same time may increase safeguarding costs to avoid costly supply disruptions. From the previous discussion, the following proposition is derived:

Proposition 1b: The use of brokerage-like Internet tools increases coordination and safeguarding costs associated with product specificity.

Frequency

Many studies further confirmed that the transaction attribute frequency is also an antecedent of the use of Internet tools (Choudhury et al., 1998). Purchases which are made at a relatively low frequency have a greater suitability for brokerage-like tools, because a low frequency does not enable a routinization of exchange between market participants, and thus does not lead to a reduction of transaction costs (Choudhury et al., 1998). We would therefore expect that recyclable wholesalers who trade certain materials infrequently will use brokerage-like Internet tools to search for buyers offering the best price (Choudhury et al., 1998). Further, sellers may incur more costs to discover the market price through bilateral negotiations of infrequently sold goods, since they lack the specific contacts and feel for the market. Sellers may in such situations be more likely to use brokerage-like tools such as Web-based auctions to discover prices.

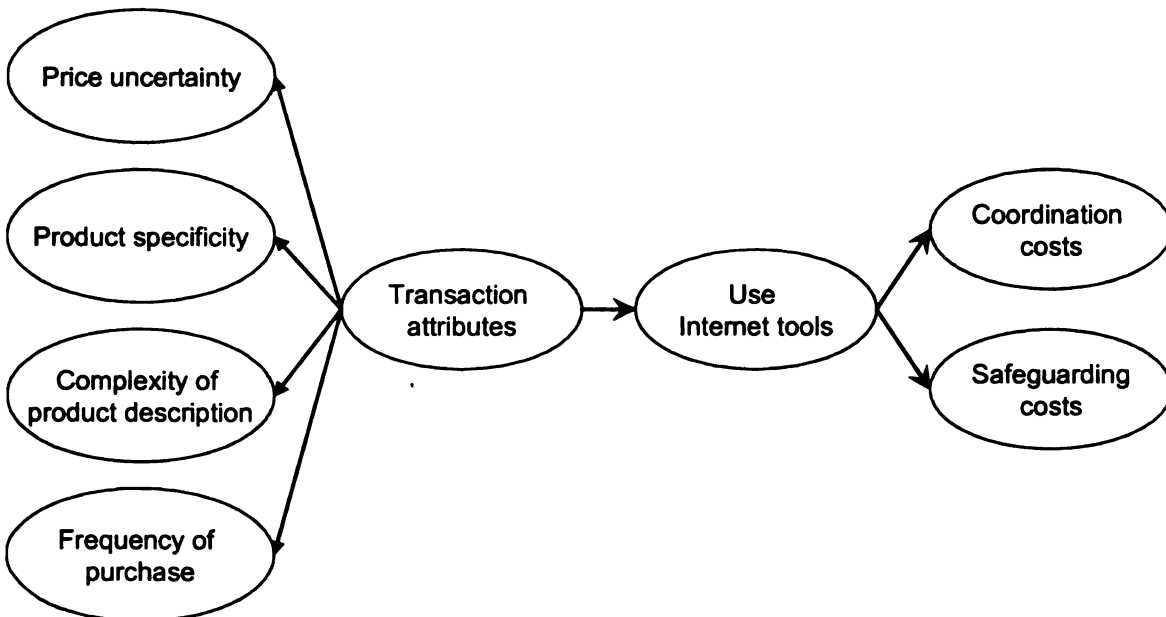
The use of brokerage-like tools may also reduce safeguarding costs associated with low frequency. According to TCT, a low frequency of transactions would increase safeguarding costs due to the lack of the reputation effect. However, brokerage-like Internet tools may introduce, for example, reputation systems, which help sellers assess

the credibility and trustworthiness of the buyers (Miller, Resnick, & Zeckhauser, 2005; Pavlou & Gefen, 2004b; Resnick, Zeckhauser, Friedman, & Kuwabara, 2000; Zacharia & Moukas, 2000). Previous discussion leads to following proposition:

Proposition 1c: The use of communication and brokerage-like Internet tools will reduce coordination and safeguarding costs associated with infrequent transactions.

The influence of transaction attributes on the use of Internet tools is presented below in Figure 8.

Figure 8: Transaction attributes



2.6.3. Capabilities of Internet tools

Malone *et al* argued that improvements in IT capabilities influence transaction attributes, whereas Williamson provides arguments against the role of technology in the rise of the firm (Englander, 1988), and the interdependence between technology and transaction costs (North, 1981, p. 169). However, Malone *et al* provide several arguments for why the IT artifact and its communication and brokerage capabilities influence governance structures. Previous studies focused predominantly on brokerage capabilities employed in unbiased e-markets, but underrepresented the communication capabilities of Internet tools. Two capabilities of Internet tools are distinguished. First, there is the ability to connect buyers and sellers (from one-to-one to many-to-many). Second, Internet tools can be used to communicate digital representations of products.

Capability of Internet tools to facilitate connectivity between buyers and sellers

The brokerage capability of an Internet tool depends on the degree to which an Internet-based tool can facilitate (inter-organizational) exchange. Malone *et al* associated brokerage-like capabilities with the number of buyers and sellers participating in a market, since the benefits of brokerage increase with the number of buyers and sellers. For example, auctions cannot be held between only one buyer and a seller (referred to as a dyad) since multiple bidders are needed; these are likely to be found when considering a value chain segment. Email, on the other hand, can be used to facilitate exchange between two individuals, but also to communicate with many firms at once through, for example, email broadcasts. The capabilities of Internet tools to connect individuals and groups are acknowledged by others as well (Flanagin, Monge, & Fulk, 2001; Fulk, Flanagin,

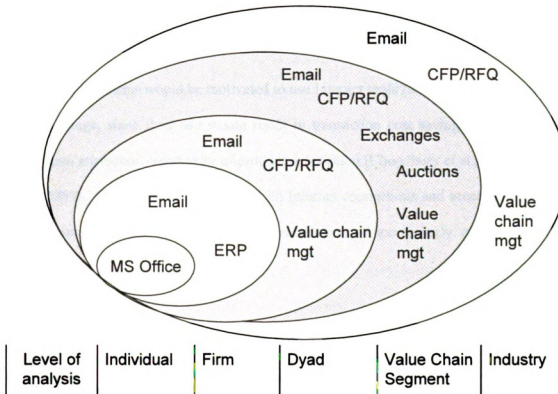
Kalman, Monge, & Ryan, 1996). The differences in the facilitation of exchange are schematically visualized in Figure 9.

Web-based auctions can be used by recyclable material wholesalers to reduce solicitation costs and to reach more potential buyers (see par. 2.4.1). However, a few studies have argued that B2B e-markets oftentimes provide few new opportunities for producers located in developing countries for example in Africa to gain access to markets in Europe and the United States (Moodley, 2003; Pare, 2003). Email can be used to support bilateral negotiations, e.g., by sending purchase contracts. Furthermore, buyers may use broadcast emails to indicate that they are willing to buy material from a selected group of sellers.

From the previous discussion, the following proposition is derived:

Proposition 2a: Connectivity capabilities enabled by communication and brokerage-like tools reduce coordination costs.

Figure 9: Connectivity capabilities to facilitate exchange



Electronic representation of products and the complexity of product descriptions

A specification of these capabilities could improve our understanding of their role within inter-organizational exchange³⁰. First, communication-like Internet tools may create new possibilities for electronically representing products up for sale. Some scholars argue that the digital representation of products directly affects the evolution from hierarchies to e-

³⁰ Other definitions of IT capabilities are strongly linked to the resource-based view of the firm (Byrd & Davidson, 2003; Zhu & Kraemer, 2002).

markets (Granados et al., 2005). However, digital representation of products fits perfectly within the communication effect of Malone *et al* and is therefore regarded as a capability of Internet tools.

It is argued that firms would be motivated to use Internet tools facilitating communication and brokerage, since their use would result in transaction cost savings, concerning the transaction attributes' complexity of product description (Choudhury et al., 1998; Malone et al., 1987). For example, high-bandwidth Internet connections and access to databases enable more efficient and effective communication of increasingly complex product descriptions.

The recycling industry is confronted with heterogeneous materials. The improved digital representation of materials would enable market actors to more quickly assess the quality and characteristics of materials. Further, digital images can be used to improve communications and thus reduce safeguarding costs needed to identify and resolve specific buyers' complaints concerning the purchased materials, e.g., specific contaminations. For example, digital pictures are used for documentation purposes when problems arise after transactions are made (Rivard et al., 2004). From the previous discussion, the following proposition is derived:

Proposition 2b: Communication-like Internet tools improve the digital representation of products, reducing coordination and safeguarding costs associated with the complexity of product description.

2.6.4. Value-to-weight ratio

It has been shown that a higher product value leads to a greater use of brokerage-like Internet tools (Choudhury et al., 1998; Klein, 1998), because a higher product value reduces the relative importance of transportation costs related to selling products over greater distances. Since transportation costs are strongly influenced by the weight of shipped products, we argue that the value-to-weight ratio is an improved specification of this property of inter-organizational exchange product value.

The value-to-weight ratio strongly influences the exchange of recyclable materials (Interview UE, PF, PE)(Fenton, 1997; Fenton, 1998). For example, recyclable material wholesalers might sell materials with a relatively high value-to-weight ratio (e.g., copper and aluminum) over great distances, whereas materials with a relatively low value-to-weight ratio (e.g., iron and steel) primarily serve regional markets. Communication-like tools may be used to facilitate communication over greater distances, enabling sellers to reduce the costs of exporting non-ferrous metals. Brokerage-like tools may be used to sell non-ferrous materials, since their relatively high value-to-weight ratio can attract a large number of buyers around the globe. This study does not derive a proposition, since we will focus only on recycling firms which are processing and wholesaling non-ferrous metals which have a relatively high value-to-weight ratio.

2.6.5. Relational embeddedness

The work of Malone *et al*, and many other studies, on the use and effects of Internet tools grounded in TCT , ignore the atmosphere concept. Williamson argues that transactions take place within a “trading atmosphere” (Williamson, 1975, p.37)³¹. Atmosphere acts as a social control mechanism of the behavior of firms (Jones et al., 1997) which may reduce opportunism (Gander & Rieple, 2004), and influences the choice of a coordination mechanism (Williamson, 1975, p.37). The failure to incorporate the atmosphere concept may have distorted the assumptions of the EMH of Malone *et al*. However, atmosphere is used in an incoherent manner and on an ad-hoc basis, often when transaction attributes fail to explain the observed choice of governance structure.

Studies of Internet use and effects may have left out the atmosphere concept for reasons such as conceptual vagueness. Atmosphere seems to be an unspecified container concept within TCT used to address the complex nature and multifaceted properties of inter-organizational exchange, to a point beyond transaction attributes. For example, atmosphere is only used as an additional explanation if the specific transaction attributes fail to explain the observed choice of governance structure. Also, the atmosphere concept lacks clear definition (e.g., TCT incorporates atmosphere in an incoherent manner and on an ad-hoc basis) and specified mechanisms (e.g., there is no clear relationship between atmosphere and transaction attributes). Moreover, atmosphere lacks a thorough

³¹ “A more satisfying trading atmosphere sometimes obtains” (Williamson, 1975).

identification of the interdependencies with transaction attributes and technological capabilities. For example, Malone *et al* EMH implies that IT capabilities (e.g., communication and brokerage) also influence the choice of governance structure and subsequently transaction costs.

Many scholars have pointed out the limits of the explanatory capabilities of transaction cost theory concerning the use and effects of Internet tools (Kraut et al., 1999; Sawyer et al., 2003)³². Transaction costs economics view transactions as discrete, atomistic and formalized interactions and relationships, often in isolation of social structures and processes such as trust (Hawkins & Verhoest, 2002; Sarkar, Butler, & Steinfield, 1998). However, transactions may in fact be composed of a multifaceted set of functions (Adelaar, 2000; Sarkar et al., 1998). Even transactions executed on the assumed anonymous commodity and stock exchanges occur within a social context (Baker, 1984). TCT focuses on the qualities of transaction instead of on the qualities of relationship.

Embeddedness is a social³³ and economic concept utilized to understand the influence of social structure on inter-organizational interactions (Granovetter, 1985; Polanyi, 1944; Schumpeter, 1943). Social embeddedness assumes that transactions and exchange are an intrinsic part of social and cultural structures (e.g., social norms and beliefs) (Crowston &

³² The problem may not be necessarily transaction theory itself, but rather that some may have interpreted transaction cost theory (too) narrowly. Further, researchers may have left out critical additional constructs, which are interrelated with transaction attributes, such as atmosphere.

³³ The term “social” refers in Latin to companion, friend, ally and associate (Merriam-Webster Inc., 1995).

Myers, 2004; DiMaggio & Louch, 1998; Granovetter, 1985). The embeddedness approach introduces the assumption of cooperation (Granovetter, 1985; Smelser & Swedberg, 1994; Uzzi, 1997). Motivations of actors are not purely rational or bounded rational (Uzzi, 1997), but also display characteristics of emergent and expert rationality as well. It is argued that “exchange typically is embedded in social structures in which opportunism is the exception, rather than the rule” (Chisholm, 1989; Granovetter, 1985; Heide & John, 1992, p.32; Shapiro, 1987). Economic exchange is situated within patterns of social relations which influence the behavior of market actors (Baum & Dutton, 1996; Granovetter, 1985; Polanyi, Arensberg, & Pearson, 1957). The embeddedness approach argues that the maximization of individualistic gain and economic self-interests are constrained by components of an embedded relationships such as trust, information sharing, and joint-problem solving (Dacin, Ventresca, & Beal, 1999; Portes & Sensenbrenner, 1993; Uzzi, 1996, 1997). Cooperative behavior occurs even in situations characterized by a small number of market participants (Uzzi, 1997). Multiple studies have shown that an augmentation of the antecedents derived from transaction cost theory with the antecedents and characteristics of cooperative behavior increased the understanding of the use and effects of Internet tools (Kraut et al., 1999). The influence of social aspects on the use of Internet tools is studied on the individual and inter-organizational level (Fulk et al., 1990; Henderson, Dooley, & Akridge, 2004; Kraut et al., 1999).

Relational embeddedness

There are three forms of embeddedness, these being relational, structural and positional (Baum & Dutton, 1996; Dacin et al., 1999; Granovetter, 1985; Gulati & Gargiulo, 1999; Jones et al., 1997)³⁴. Relational embeddedness focuses on the content of relationships such as their quality, cohesion, behavioral and attitudinal orientations, which in turn are described by three main mechanisms, namely trust, joint-problem solving, and information sharing (Jones et al., 1997; Uzzi, 1996). Historically, the organization of production in societies was often achieved through social relationships of kin, community obligations and reciprocity (counter obligations) (Polanyi et al., 1957). Individuals representing firms form formal and informal cooperative and interdependent relationships with other individuals in different firms to facilitate and perform transactions (Morgan & Hunt, 1994). Business relationships are the contextualized patterns of social interactions or connections between business people (Mandjak & Simon, 2004; Merriam-Webster Inc., 1995; Polanyi et al., 1957).

Components of an embedded relationships such as trust, information sharing and joint problem-solving reduce transaction costs to facilitate, coordinate and safeguard transactions (Angehrn, Nabeth, & Subirana, 2001; Bensaou & Venkatraman, 1995; Crowston & Myers, 2004; Dyer & Singh, 1998; Granovetter, 1985; Hawkins & Verhoest,

³⁴ Some scholars take a broader view on embeddedness by arguing that economic action is embedded in social structure, culture, cognition, politics, and non-market institutions (Dimaggio, 1994; Knoke, 1990; Zukin & DiMaggio, 1990).

2002; Heide & John, 1990; Uzzi, 1996). The social aspects of exchange can either enable or constrain the process of trading, exchange and competition (Gupta & Lad, 1983; Olson, 1965, 1982).

Trust

Trust refers to the degree of confidence or goodwill existing between the two trading partners (Ring & van de Ven, 1994). Trust can be considered as either an intertwined or uni-dimensional construct, having several underlying dimensions which are not discussed in this study (Geyskens, Steenkamp, & Kumar, 1998; Pavlou & Gefen, 2004a). Multiple interpersonal interactions may lead to the development of social bonds based upon shared norms (e.g., integrity), attitudes, credibility, reciprocity (e.g., goodwill), and friendships (Lane & Lubatkin, 1998). The experiences by buyers and sellers gained from past transactions may lead to the establishment and development of social bonds, such as friendship, kindness, generosity, affinity, mutual commitment, and reciprocal interests in commercial matters (Mandjak & Simon, 2004; Merriam-Webster Inc., 1995; Polanyi et al., 1957). Firms have an inclination to trade with market actors with whom they have already established social bonds, created through, for example, transactions performed in the past..

Transactions are to a certain degree unique in nature (e.g., due to heterogeneity of products), and this can create a certain degree of uncertainty between buyers and sellers. Uncertainties may concern the possibility that a trading partner may engage in opportunistic behavior (Ring & van de Ven, 1994). It may be difficult to fully specify and

control the transfer of property rights. For example, it may be too expensive and too time-consuming to incorporate all business risks within a contract. Social bonds such as trust may reduce feelings of uncertainty between transacting parties and market environments, and improve the assessment of the capabilities of the trading partner (Granovetter, 1985; Podolny, 1994; Ring & van de Ven, 1994). Relationships create a trusted and stable environment in which buyers and sellers are comfortable to engage in, discuss, negotiate, and work out the complex issues of a transaction (Oliver, 1990). Personal responsibility and consistency in interactions provide a set of expectations for the firms, which can increase their confidence (or trust) that social bonds and personal relationships help to discourage opportunistic behavior by one of the transacting parties (Granovetter, 1985). In effect, a greater reliance on trust by buyers and sellers reduces safeguarding costs, or, in other words, transaction costs are lower in situations where trust emerges.

Information sharing

Codified information is represented in symbolic forms, such as written language purchase orders and technical specifications, which can be distributed at relatively low costs (Foray, 1994; Gallouj & Weinstein, 1997; Polanyi, 1966; Rosegger, 1986; Ryle, 1950). Tacit information is often unwritten, such as know-how and practical knowledge. Tacit information resides in individuals, organizations and industries, which makes it difficult to transfer without direct experience and interaction (Gallouj & Weinstein, 1997; Gertler, 2003; Reber, 1995; Rosegger, 1986). Relationships provide ways for firms to gain access to tacit and codified non-public information and knowledge about the business needs of trading partners, as well as other business opportunities and innovations (Adant &

Gaspart, 2001; Gertler, 2003; Gulati & Gargiulo, 1999; Rosegger, 1986). For example, business partners may help firms to interpret and predict market trends to establish shared interpretations of the different aspects of a transaction (e.g., business challenges and solutions). Ongoing interactions also provide ways to increase mutual understanding and responsiveness, and help consolidate the expectations of current and future transactions between business partners. Cooperative and trusted business relationships provide businesses with incentives to share information, since it may be of benefit to the relationships themselves. Relationships also form a basis to regulate and guide such interactions.

Business relationships create a trusted environment, which improves knowledge transfer and learning (Gulati & Gargiulo, 1999). For example, business partners can also help firms to articulate particular needs not recognized before. Relationships may also help in locating and selecting parties, since business partners may provide information about the reputation of other trading partners. Relationships may also provide operational support, such as advice and access to resources (Uzzi, 1997).

Joint-problem solving

Relationships are sought after with the expectation that they may provide mutual benefits to each of the market actors, such as reciprocity (Oliver, 1990; Williams, 1997), which helps firms quickly resolve problems and disputes jointly, thereby reducing transaction costs. Joint problem-solving is the way in which trading partners adapt to new situations to efficiently resolve disagreements and disputes between them, and how sellers adapt

transactions to increase the match with buyers needs (Lusch & Brown, 1996; Uzzi, 1997). Relationships facilitate joint problem-solving, since people trust each other, and there is a greater mutual understanding and awareness of the common benefits of working together to reduce business challenges. The trade of recyclable materials is highly dependent on relationships (Adant & Gaspart, 2001). For example, situations may occur in which a buyer asks a seller to hold on to material, because the seller unexpectedly needs to perform repairs on production facilities, and is unable to store and handle materials. Sellers who meet such buyers' requests create goodwill and reciprocity, which may be beneficial in later transactions. For example, a buyer may identify specific problems with the purchased materials, which regularly occur in the trade of recyclable materials. Canceling an order can be quite costly for the seller, due to the relatively high transportation costs inherent to the transaction. Instead, the buyer may consult the seller. When the buyer and the seller trust each other, it provides more guarantees for the seller of the truthfulness and sincerity of the problem stated by the buyer. Oftentimes, renegotiations will occur to address the identified problem, which may be quickly resolved by a downgrade of the materials by the seller, thus resulting in a lower price per unit. Again, the capabilities of buyers and sellers to quickly resolve problems and adjust a transaction to specific requests reduces coordination and safeguarding costs for both parties. Additionally, the problem-solving capabilities of market actors may strengthen the ongoing relationship, and provide a basis for further cooperation and collaboration.

Positive effects of communication-like Internet tools on relationships

Communication-like Internet tools can enhance relationships. For example, real-time online pricing services enable a quicker convergence of buyers' and sellers' expectations about the fair market price based upon, for example, industry-wide accepted reference prices. Also, email enables firms to communicate and resolve specific problems more quickly and with more accuracy by, for example, exchanging digital images via email. Improved and enhanced communications reduce the likelihood that problems may get out of hand and jeopardize the relationship. Also, the exchange of digital images enable buyers to make a more informed decision on what they are willing to pay for specific materials. Digital images also reduce the likelihood of potential after-sales problems concerning the quality of materials. Internet tools may also enable faster and enhanced communications, which may help to identify and resolve issues before they get out of hand. Internet tools may therefore be able to reduce coordination and safeguarding costs associated with uncertainty and potential strategic behavior of market actors (Figure 10). Firms operating in markets characterized by a relatively high uncertainty of the performance of trading partners may have incentives to use Internet tools. For example, Internet tools can be used to gain information about the financial standing of a firm by using databases to select trading partners who are members of the industry association. The following proposition is derived:

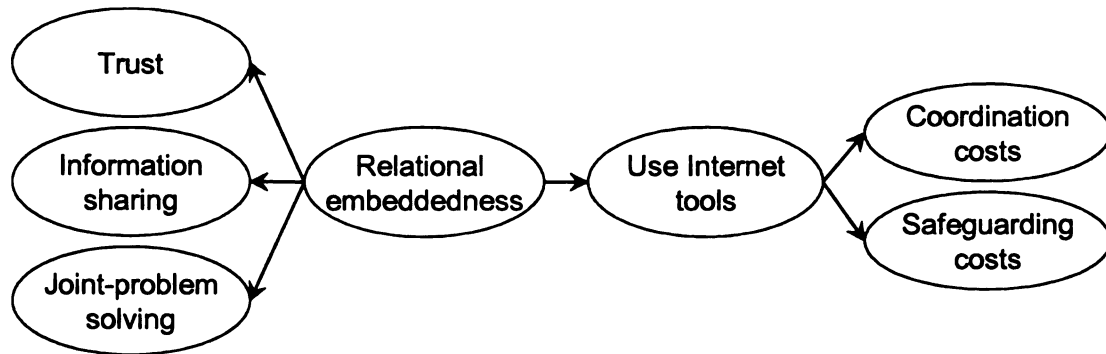
Proposition 3a: Communication-like Internet tools reduce coordination and safeguarding costs, since they enable trust, information sharing and joint problem-solving.

Negative effects of brokerage-like Internet tools on relationships

The existing ways of doing business with a number of trusted businesses might create barriers to the use of Internet tools. For example, buyers are willing to pay a premium for trusted sellers, because they trust the sellers' capability to provide consistent material quality. Furthermore, social relationships between suppliers and buyers help mitigate the problems of assessing the quality of materials and resolving potential after-sales problems. However, brokerage-like Internet tools, such as Web-based auctions, may jeopardize long-term relationships, since sellers are not able to assign the sale to specific buyers beyond its price. Web-based auctions also reduce opportunities for sellers to customize products and learn more about the specific buyers' requirements and the way buyers use the products. Moreover, open-bid Web-based auctions enable many buyers to participate in the bidding process, which can increase the uncertainty of the seller that the buyer will follow through a commitment. For example, safeguarding costs may increase, since the auction buyer is not able to pay for the materials, or does not pick up the materials as promised. The following proposition is derived:

Proposition 3b: Brokerage-like Internet tools increase coordination and safeguarding costs since they reduce trust, information sharing, and joint problem-solving.

Figure 10: Relational embeddedness



2.6.6. Variability of demand and joint planning

Variability of demand may provide incentives for firms to refrain from the use of brokerage-like Internet tools, since it does not enable market actors to plan jointly. However, materials for which demand can vary considerably (e.g., low quality materials) and which form for example only a minor part of a firm's revenue, may be more suitable to sell via the Internet, since it reduces coordination costs for the sellers. Both possibilities will be discussed below.

Joint planning refers to the implemented formal and informal actions within a relationship that deal with future events, responsibilities and duties before a series of transactions take place (Heide & Miner, 1992). Buyers and sellers pro-actively consider the goals and expectations for future transactions through, for example, entering in long-term formal contracts or informal handshake contracts (e.g., specified quantities, delivery times, and payment schedules (Claro, Hagelaar, & Omta, 2003). Social bonds, trust, and mutual understanding facilitate the formation of long-term formal and informal agreements such as handshake contracts (Interview PF). Informal agreements enable buyers and sellers to do business efficiently and effectively while at the same time reducing contracting and enforcement costs (Leiblein, 2003; Poppo & Zenger, 2002).

Recyclable material wholesalers are confronted by a market with variability of demand for recyclable materials. Relationships can provide the means in which firms can better cope with a fast-paced and uncertain market. For example, relationships with large buyers

of recyclable materials are important for recyclable material wholesalers to secure demand and relatively stable market price. Many buyers have specific needs concerning scrap materials because of, for example, differences in production facilities (Interview CB). Customization provides sellers with the opportunity to add value to a transaction, and helps them differentiate between themselves and the competition. However, customization also creates the risk of opportunism by the buyer, since customized products are harder to trade on the open market when the transaction falls through. Relationships provide the necessary trust and understanding through which both parties feel comfortable to do business and customize materials. Informal handshake contracts help firms to reduce demand variability and reduce safeguarding costs. Formalizing informal arrangements interactions are often cost prohibitive, reducing the gains from trade, and would reduce the flexibility to adjust to changing market circumstances. The relational embeddedness of business relationships reduces the need for formalized long-term contracts, but at the same time enables joint planning, which reduces variability of demand and secures resources (Galaskiewicz, 1985). Buyers of scrap metal may use email to distribute purchase tenders, thereby improving joint planning. As such, the following proposition is derived:

Proposition 4a: The use of communication-like Internet tools enable joint planning which reduces coordination and safeguarding costs associated with variability of demand.

Variability of demand may heighten the uncertainty among sellers about their ability to sell their goods³⁵. Sellers may be uncertain about the potential to sell their goods with the help of brokerage-like Internet tools such as Web-based auctions. Web-based auctions may increase the seller's exposure to variations in demand, because auctions do not guarantee that the seller will be able to sell their goods. For example, auctions tend to focus on price, so there are only limited ways for buyers and sellers to establish business relationships. Therefore, buyers at auctions are more likely to lack commitment and will not feel obligated to purchase future offerings of materials from a specific seller. In periods of decreasing prices, demand may reduce accordingly, and sellers may run the risk that the auction is not completed, due to a lack of potential buyers (Vragov, 2005)³⁶. In effect, Web-based auctions may increase the uncertainty of sellers to find a trading partner online. During times of lower demand, buyers may prefer to deal with people with whom they have established relationships with, instead of dealing with online buyers to which they are uncommitted. Thus, auctions tend to increase the variability of demand as well as uncertainty regarding long-term price stability. From the previous discussion, the following proposition is derived:

Proposition 4b: The use of brokerage-like Internet tools reduces the ability to plan jointly, thereby increasing transaction costs associated with the variability of demand.

³⁵ An overview of other disadvantages of auctions is provided by other scholars (Klemperer, 2002).

³⁶ Other scholars have also found that a lack of participants can result in unsuccessful auctions (Carter et al., 2004).

2.6.7. Inter-organizational routines

Evolutionary economics criticize transaction cost theory because of its (comparatively) static and isolated perspective on transactions as a unit of analysis. In addition, it is argued that the behavioral assumptions of transaction costs theory are complementary to evolutionary economics (Langlois, 1986; Williamson, 1985, p. 47). Nelson and Winter (1982) argue for the study of the ability of firms to reduce cost and to survive at the level of the firm. Evolutionary economists argue that behavior is guided by routines which are the “genes” of the firm (Dosi, 1982; Winter, 1986). There is considerable agreement in the literature that organizational routines can be defined as repetitive, recognizable patterns of interdependent actions, carried out by multiple actors, (Feldman & Pentland, 2003), through common practices, conventions and business practices. Firm behavior such as the ability to change and react to market challenges is based on these routines (Nelson & Winter, 2002). Evolutionary economics argue that firms are not as motivated as would be expected in light of the neo-classical assumption of profit-maximizing behavior. Instead, routines limit the search and selection process of market actors (Dosi, 1982; Winter, 1986). Firms are satisfied with a solution for market challenges which is closely related to existing routines, to avoid potential conflict or disruption of the routines themselves (Douma & Schreuder, 1991). A competitive environment will favor those firms who selected, invented and/or imitated routines offering the greatest benefits (Mathews, 2001). Firms try to replicate and imitate successful routines of other firms, leading to a cumulative retention of routines within an industry (Dosi, 1982; Winter, 1986).

Relational routines

The focus of this study is on routines occurring on the inter-organizational level, and is less interested in routines on an individual or firm level (Steen, 2003). Past interactions, recurrent transactions and trade activities accumulate in specific patterns or habits of thought and action referred to as inter-organizational routines (Steen, 2003; Zollo, Reuer, & Singh, 2002). Variations in inter-organizational routines are path-dependent and intertwined with the context of exchange (Nelson & Winter, 1982; Dosi & Marengo, 1994). Interactions between a buyer and seller are often governed by specific relational routines formed through learning the effects derived from previous interactions (Steen, 2003). Inter-organizational routines provide direction for future exchanges and expectations of trading partners. Relational routines “will influence the way the two firms will negotiate future agreements among themselves due to the path-dependent nature of repeated behavior within a given context” (Zollo et al., 2002, p.705)³⁷.

Industry routines

Industry routines refer to widely-shared recurrent patterns of actions among market actors within a specific industry value segment. Industry routines facilitate inter-organizational exchange and guide the way firms do business, concerning, for example, the use of price discovery mechanisms which can reduce transaction costs. For example, recyclable material wholesalers have specific ways to solicit prices, enabling them to negotiate with multiple buyers concurrently, while still being able to compare the quotations on specific

³⁷ The authors reference to other scholars as well namely (March & Simon, 1958; Nelson & Winter, 1982).

dimensions. A seller of recyclable materials can contact a potential buyer with a request for quotation. The buyer and seller may not be familiar with each other, but the firms are still able to engage in negotiations because of industry-wide accepted and applied routines. There are many other examples supporting the fact that industry-wide routines reduce transaction costs.

Categories of routines and the recycling industry

Four categories of routines are discussed and applied to the recycling industry below (Cohen et al., 1996; Winter, 1986). We will focus on the ostensive aspects of inter-organizational routines (thus people's ideas about and understanding of the routine) (Cohen et al., 1996; Feldman & Pentland, 2003):

- **Routines in a narrow context:** Routines in a narrow context refer to repetitive behavior that is almost automatic and unconscious (Cohen et al., 1996). Examples of “narrow” inter-organizational routines are related to activities such as pre-sale, sale, fulfillment, and after-sale. For example, a wholesaler will call about five to ten potential buyers with whom they regularly do business, to ask for price quotes for a specific load of material. The wholesaler has learned over time that these firms give the best quotes (including price and other aspects of a transaction). The seller will evaluate the quotes, considering price, delivery etc. The seller may still not be convinced, so they decide to call back the three firms that provided with the best quotes. The seller makes another sales pitch to explain the value of the material to the buyer, and tries to bargain for a higher price. Eventually, the seller may decide to sell to the firm who makes the best offer.

- **Rules of thumb:** “Rules of thumb are relatively simple decision rules that are consciously invoked and require low levels of information processing” (Cohen et al., 1996). Rules of thumb enable market actors to quickly assess a solicited quote or business proposition. Rules of thumb also concern pricing of long-term contracts. For example, firms may discuss a purchase order for six months, which is commonly tied to a specific price index of a commodity exchange.
- **Heuristics and strategies:** This category of routines refers to “concepts and dispositions that provide orientation and a common structure for a range of similar problem-solving efforts, but supply few if any of the details of individual solutions” (Cohen et al., 1996). For example, sellers often have to follow a strategy to “buy low, sell high” to maximize profit. Also, sellers who negotiate a price will “always ask for more than they would be willing to settle for” (Cohen et al., 1996). Furthermore, sellers who deal with a new buyer do not find it a problem (and even encourage) buyers to order a test load to inspect the quality and content of the materials. Furthermore, market actors might recognize that they need to make fast decisions, and therefore sometime pay too much or sell too cheap. However, sellers might be comfortable doing business because they assume that “sometimes you win, sometimes you lose”.
- **Paradigms and cognitive frameworks:** This category refers to “frameworks which provide meaning and understanding through the application of cognitive processes such as problem-solving and perception” (Cohen et al., 1996). This category has a very high level of abstraction, which would be difficult to assess through a cross-

sectional analysis. Therefore, it is decided to drop this category from the rest of this study.

Routines related to price discovery mechanisms

The historic choice of the use of a specific price discovery mechanism within an industry segment (e.g., negotiations) leads to the establishment and development of industry-specific trade routines (e.g., trade conventions and practices) (Biggart & Beamish, 2003; Schultze & Boland, 2000). Industry-wide trading routines can reduce transaction costs related to the use of a specific price discovery mechanism in use, such as routines which speed up negotiations. The path dependency of routines provides incentives for firms to only change those industry routines, which minimize resistance among industry participants (Nelson & Winter, 1982; Niosi, 1998). Therefore, market actors have incentives to use those Internet-tools which enhance existing industry-wide, inter-organizational routines related to, say, negotiations, inventory management, problem-solving and production. Communication-like Internet tools may enhance industry-wide negotiation routines. For example, exchanging purchase contacts may be done by email instead of a fax. Further, recycling firms may send pictures of materials, instead of sending a test load of physical materials. Email pictures may therefore reduce the time of interaction by several weeks or even months in international negotiations. The following proposition is derived:

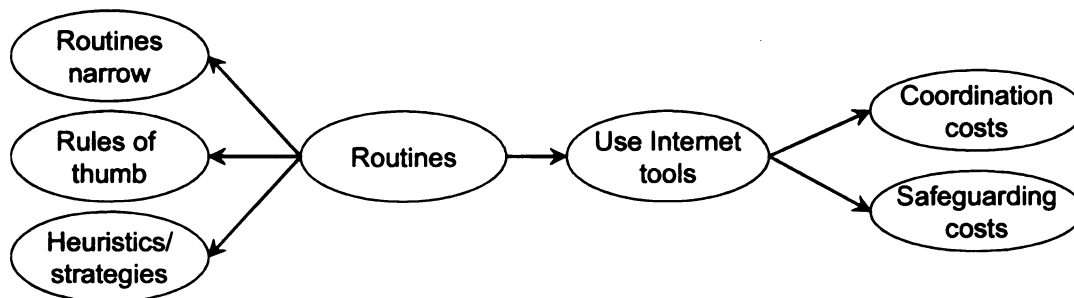
Proposition 5a: Communication-like Internet tools (e.g., email and real-time data feed services) enhance existing industry-wide exchange routines and reduce transaction costs.

Brokerage capabilities and routines

Recycling firms are used to negotiate deals bilaterally with multiple firms at the same time. This is partly facilitated by industry-wide routines tied in with negotiations. The introduction of a brokerage-like Internet tool (e.g., Web-based auctions) is a fundamentally different way to discover prices, in comparison to negotiations. Web-based auctions may therefore require market actors to change or alter the three categories of routines, as well as introduce new ones on an industry-wide scale (see Figure 11). Such change of routines and introduction of new ones may induce resistance among industry participants (Nelson & Winter, 1982; Niosi, 1998), who are then less likely to participate in online auctions. Thus, a potential change of routines caused by Web-based auctions may increase the perceived transaction costs among market actors, which can result in the non-use of Web-based auctions. For example, industry-wide negotiation routines enable sellers to quickly search and compare multiple offerings of different buyers, thereby reducing coordination costs. Also, established industry routines (e.g., negotiating a downgrade in price) can make it easier for sellers to resolve buyers' complaints after they have received the ordered goods, reducing safeguarding costs. The following proposition is therefore derived:

Proposition 5b: Brokerage-like Internet tools (e.g., Web-based auctions) which dislodge existing inter-organizational exchange routines increase both coordination and safeguarding costs.

Figure 11: Inter-organizational routines and the use of Internet tools

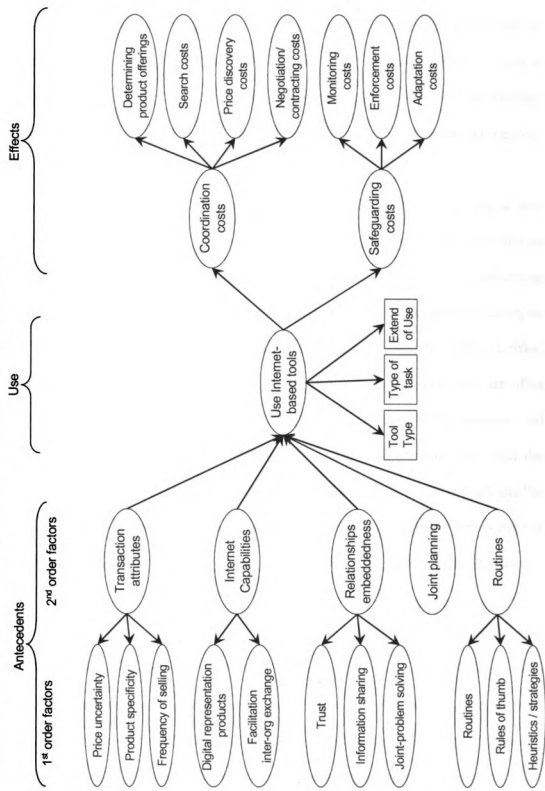


2.6.8. Interdependencies

Overview of framework

The theory review identified the specific inter-organizational exchange properties, as well as the first order factors. It is argued that inter-organizational exchange properties form the antecedents of the use of Internet tools, and may affect transaction costs as represented in Figure 12. Also, we derived specific propositions applied to the characteristics of the recycling industry.

Figure 12: Detailed framework of Internet tools' antecedents, use and effects



Transition of price discovery mechanisms

Malone *et al* fail to recognize that the use of brokerage-like Internet tools may imply the introduction of a price discovery mechanism not previously employed within an industry value segment. For example, firms might be accustomed to doing business and exchange materials through concurrent bilateral negotiations instead of using (Web-based) auctions.

Transaction cost theory and studies on the use of Internet tools provide only a very limited explanation of how the industry would evolve from one situation to another (Malone et al., 1987; Williamson, 2000). There are surprisingly few studies addressing the industry-wide transition from one price discovery mechanism to another, for example, moving from negotiations to auctions (Bajari, McMillan, & Tadelis, 2002; Leffler, Rucker, & Munn, 2003). Studies on transition of price discovery mechanisms are often based on static comparative analyses, which consider transactions to be atomistic and study them in isolation. By doing so, these studies tend to ignore the firm, and the multifaceted aspects of transactions (Adelaar, 2000; Sarkar et al., 1998). Additionally, these TCT analyses tend to ignore other inter-organizational exchange properties besides transaction attributes, such as relational embeddedness and inter-organizational routines.

Studies on the comparative efficiency with different price discovery mechanisms often provide the rationale for the choice of market actors to discontinue an “inefficient” price discovery mechanism (e.g., negotiations) and to replace it with a more “efficient” one (e.g., Web-based auctions). It is assumed that market participants will select and use the most efficient price mechanism with the minimal amount of effort. The atomistic and

isolationist view on transaction has thus resulted in a notion that price discovery mechanisms are also atomistic and isolated. This implies that mechanisms are portable or footloose, and that firms can switch price discovery mechanism or governance structures easily within any industry segment without significant transition costs.

Portability and interdependencies

The portability of price discovery mechanisms, however, implies a fairly narrow economic interpretation of inter-organizational exchange. There are several arguments the assumption that a substitution or transition of price discovery mechanisms is much more complex than TCT represents. For example, a focus on transaction attributes in determining the choice of governance structure may prevent researchers from recognizing the influence of these interdependencies on the choice of governance structure (Mahnke, 2001). Studies point out that the “focus on the transaction as the unit of analysis can obscure interdependencies between transactions” (Argyres & Liebeskind, 2000, p.238), and that the “governance of any new transaction in which a firm engages may become linked inseparably with the governance of other transactions in which the firm is already engaged” (Argyres & Liebeskind, 1999).

Inter-organizational routines associated with a specific price discovery mechanism evolve together with other inter-organizational properties (e.g., relational embeddedness and transaction attributes). Over time, specific interdependencies may develop between them and thereby become intrinsically linked with each other. For example, negotiations enable business people to build trust between each other over a series of exchange episodes (e.g.,

through personal meetings and phone calls) (Mandjak & Simon, 2004). Increased familiarity between market participants and the use of a price discovery mechanism may result in the development and use of specific inter-organizational routines (Biggart & Beamish, 2003; Schultze & Boland, 2000). Inter-organizational routines related to a specific price discovery mechanism are then enacted within business relationships, in this way enabling market actors to reduce transaction costs even further.

Historical choices could influence the present trade-off between different price discovery mechanisms. Market actors may be limited in their choices, due to the path dependency of price discovery mechanisms caused by the interdependencies among exchange properties. These observations reduce the relevancy of TCT -based analysis of static comparative efficiency of different price discovery mechanisms, since these studies a) do not take into account how such transition would occur and b) ignore transition costs of substituting a price discovery mechanism in the context of inter-organizational exchange on an industry level. The static comparative analyses grounded in TCT often neglected the multifaceted character of transactions, and the interdependencies between inter-organizational exchange properties. Therefore, comparative efficiency analysis of price discovery mechanisms may have led to an underestimation of transition costs related to a fundamental change in the industry-wide use of a price discovery mechanism. The costs might be reflected by the reluctance of market actors to use a new and so-called “more efficient” price discovery mechanism.

Internet tools and the recycling industry

The properties of inter-organizational exchange and the interdependencies among them may affect the governance structure within the recycling industry, and subsequently transaction costs. We expect that the use of brokerage or communication-like capabilities of Internet tools affects individual exchange properties, as well as the interdependencies among them. Transaction costs may be affected depending on the specific change of the exchange properties, their interdependencies and their combined effect on transaction costs. Firms select and use Internet tools with the altering of exchange properties and their interdependencies in mind. The interdependencies among inter-organizational exchange properties could constrain or promote the use of communication or brokerage-like capabilities of Internet tools.

For example, the introduction of a new price discovery mechanism could mean the loss of existing business relations, and could require a modification of inter-organizational routines (e.g., the way of selling recyclable materials). Change may be very difficult or even impossible (Nelson & Winter, 1982; Niosi, 1998). For example, a loss of business relationships may threaten the very existence of the firm. Further, a modification or development of new trading routines may require intensive learning (e.g., avoiding overbidding or perception of dishonest behavior). Still, it is uncertain if new routines (e.g., checking quality of materials based on a rating system of sellers and buyers) will gain industry acceptance. A lack of industry acceptance may jeopardize the effectiveness of such routines and instruments to reduce transaction costs.

The question is not necessarily about the efficiency of price discovery mechanisms offered by Internet tools, but rather about the fit or match of the capabilities of Internet tools with (the interdependencies of) the exchange properties. For example, the fit argument addresses the perceptions firms have on the substitutability of business relationships and price discovery mechanisms over other forms of exchange (e.g., more competitive ones). The perceived fit of different capabilities of Internet tools (including implied price discovery mechanisms, such as Web-based auctions or email) with exchange properties may affect the selection of Internet tools, the extent of their use and resulting transaction costs. In effect, the path dependency of price discovery mechanisms and associated transition costs may, for example, explain the relatively low uptake of Web-based auctions and the relatively high use of email within inter-organizational exchange.

Reduced relevancy of comparing trading systems

This study does focus on evolutionary trajectories related to the historic choice of technological capabilities that are associated with the three forms of price discovery mechanisms. However, this should not be confused with studies on the use of or transition from one specific trading system to another. For example, comparative analytical studies predominantly looked at the use and effects of the transition of trading system, such as the transition from open-outcry floor-trading to screen-based trading (Grossman, 1990; Martens, 1998; Tse & Zabolina, 2001; Turkington & Walsh, 2000). Also, studies on electronic markets also focus predominantly on the use and effects of individual trading systems. For example, market participants in certain industries (e.g., producers) do not

always accept a particular price discovery (Purcell, 1997), partly dependent upon the degree of use by market participants (Thraen, 2003). These explanations refer to network externalities and path dependencies of specific technologies, or in this case, trading systems (Arthur, 1989). However, use and effects of individual trading systems or comparison of the success factors between two systems (e.g., e-steel.com or isteelasia.com³⁸) should not be interpreted as a comparison of two different price discoveries, or an explanation of the differences in the use and effects of price discovery mechanisms on an industry-wide level.

Interdependencies and Internet capabilities vs. restructuring organizations

The comparative efficiency of Internet tools provided the theoretical basis of the advantages of both the communication and brokerage capabilities of Internet tools. Scholars recognized the embeddedness of trading and business activities, and often focused on how companies and industries should align themselves (e.g., restructuring business processes to facilitate the implementation and use of new price discovery mechanisms) to maximize benefits from the use of Internet tools (Brynjolfsson & Hitt, 2000; Markus, 1983; Scott Morton, 1991). The idea that firms need to adapt to implement and use Internet tools might have created a bias towards the universal benefits of Internet tools. For example, these studies did not take into consideration the fact that changing the

³⁸ More steel exchanges are listed on

http://r0.unctad.org/infocomm/exchanges/e_exchange/e_ex_metals2.htm

price discovery mechanism goes beyond a comparative efficiency analysis and renews alignment of business processes and strategy.

Firms may simply select and use those Internet tools applications which best fit and match the inter-organizational exchange properties, as well as the interdependencies among them, and ignore the rest (Schultze & Moreau, 2000). Firms can choose among a wide variety of Internet tools with different capabilities and “tied-in” price discovery mechanisms. These mechanisms may fit conditions (exchange properties and interdependencies) not considered by studies of electronic markets, and studies of the adaptation of firms leading to changes in predicted uses and effects. The discussion above led to the following proposition:

Structuration of the use of Internet tools

The continuous development of Internet tools (e.g., new software programs, updates, added features such as email attachments, people switching to broadband Internet, automated bidding features of online auctions) influences not only their use, but also their effects on transaction costs. However, why technologies are adopted is not based solely on the intrinsic elements of said technology. It is also argued that the use of technologies is shaped by social structures and social groups (e.g., buyers and sellers of recyclable materials), referred to as the “social construction” of technology (Bijker, Hughes, & Pinch, 1987) (Dosi, 1982; Sahal, 1985). The interaction between social groups and technology may influence technological evolution, such as the use of email (Fulk et al., 1990; Markus, 1994; Rice & Rogers, 1980).

It is also observed that users adapt and modify the use of IT tools to suit their business needs, a process often referred to as reinvention or structuration of technology use (Johnson & Rice, 1984; Rogers, 1995). Adapted from social constructivism (Bijker, 1995; Pinch & Bijker, 1987) and structuration theory (Giddens, 1979, 1984), the structuration of technology view (Desanctis & Poole, 1994; Jasperson, Carter, & Zmud, 2005; Majchrzak, Rice, Malhotra, King, & Ba, 2000; Orlikowski & Robey, 1991; Orlikowski, 1992, 1996; Orlikowski, 2000; Orlikowski, Yates, Okamura, & Fujimoto, 1995; Pauleen & Yoong, 2001; Schultze & Orlikowski, 2004; Speier & Venkatesh, 2002; Walsham & Han, 1991) attempts to explain “why people choose to reinforce, ignore, enhance, undermine, change, work around, or replace existing structures of technology use” (Orlikowski, 2000)³⁹. The approach of the structuration of technology use criticizes social constructivism on two points. First, social constructivist approach assumes that technologies stabilize after the design and development phase, after which consensus and closure are reached among social groups (Pinch & Bijker, 1987). However, it was observed that people modified and redefined the use of technologies and technological elements, and assigned meaning beyond the design and developmental phase, and/or beyond original intention of the designers/developers (Bijker, 1995; Hippel, 1988; Johnson & Rice, 1984; Majchrzak et al., 2000; Rice & Rogers, 1980). In addition, development of technology artifacts, such as

³⁹ This structural view of technology is closely related to the adaptive structuration perspective (Desanctis & Poole, 1994), but here we follow the structuration of technology view to reduce ambiguity.

increased possibilities to personalize software applications, strengthens the assumption that the stabilization of technology is only temporary (Orlikowski, 2000).

Second, the structuration of technology view assumes that technology embodies social structure but that technology itself does not possess social structure in itself. Here social structure is defined as “a set of rules and resources” (Giddens, 1979, 1984). The perspective on the structuration of technology use assumes that structure materializes from the repeated use of technological artifacts (e.g., a software program) structuring human action in such a way that technological elements become associated with rules and recourses of situated and repeated social practice⁴⁰ (Orlikowski, 2000; Sewell, 1992).

In sum, it is argued that the repeated interaction between people and Internet tools enacts typical structures of technology use. Technological elements provide a space of affordances for technology use (Heeter, 2000; Orlikowski, 2000, p. 409). Therefore, use of Internet tools is open-ended and not predetermined, instead being the result of this use itself, as well as experiences, time, circumstances and people (Heeter, 2000; Orlikowski, 2000). It should be noted that the structuration of technology use goes beyond the meaning of reinvention, which refers only to the use of a tool for a purpose not originally intended by its creators.

⁴⁰ For a more detailed discussion on practice please refer to (Bourdieu, 1977, 1998).

Peoples' situated use of technology changes continuously because the interaction of users with technology may lead to the modification and reinvention of the characteristics of technologies. Over time, the emergent structure of technology use may also changes facilities (e.g., software application), norms (e.g., netiquette) and interpretive schemes (e.g., assumptions) of the technology (Orlikowski, 2000). The emergent patterns in use (e.g., specific activities and routines) may fit or be unfit for industry-wide norms, values and beliefs (Abrahamson & Fombrun, 1994; Dimaggio & Powell, 1983; Hawkins & Verhoest, 2002; Hoffman & Ocasio, 2001). For example, it may be standard practice to send an email confirmation of a phone conversation or oral agreement, this being regarded as promoting openness, responsibility and accountability.

Incentives to change the use of Internet tools may be introduced to accomplish a reduction of transaction costs. However, the use and structuration of the use of Internet tools may facilitate new forms of strategic behavior, which can increase or decrease coordination and safeguarding costs. For example, sellers on Web-based auctions may try to solicit high bids, but eventually negotiate a deal with a trusted but high bidder offline. These new forms of strategic behavior (thus use) may be in conflict with existing prevailing industry norms and values (e.g., fairness and integrity). A conflict between potential usage and industry norms and values may lead industry participants to view Internet tools as allowing "unethical" behavior and thus increasing safeguarding costs. As a result, market actors may then simply refuse to use the Internet tool.

Other aspects of the use of Internet tools are also structured and can lead to changes in behavior, which still fit inter-organizational exchange properties, social norms and values. Such new usages can thus reduce coordination and safeguarding costs. For example, email may be used as a broker-like tool when a buyer sends or broadcasts emails to multiple sellers. Also, email may be used to exchange digital images detailing the way materials were loaded, after receiving complaints from the buyer, thus reducing safeguarding costs. The following proposition is derived:

Proposition 6: The structuration of the use of Internet tools enables a reduction of transaction costs when its uses match the interdependencies between two or more properties of inter-organizational exchange.

3. METHODS

Below will be described the case study method, the unit of analysis, instrumentation such as the interview protocol and procedures, selection criteria of the cases and validity issues.

3.1. *Justification of performing qualitative case studies*

The contradictions between EMH and observations in the field strengthened the choice of selecting the case study method. First of all, case studies are ideal to explore the complex interactions between a phenomenon and its real-life social, spatial and temporal context. Examples of phenomena are inter-organizational relationships and management of information systems (Markus, 1983; Orlikowski & Baroudi, 1991; Yin, 1993). Secondly, case studies enable us to answer the "how" and "why" questions (Benbasat, Goldstein, & Mead, 1987) and to uncover and understand the underlying dynamics (e.g., interdependencies) between constructs (Perry, Riege, & Brown, 1999). Causal relationships as assessed by the Karl Pearson's coefficient of correlation are not always sufficient to explain the nature and characteristics of the relationship. Thirdly, we had no control over the exchange between firms and therefore could not perform experiments. Finally, augmentations of behavioral assumptions were expected due to the observed contradictions. The case study method enables us to develop, build and revise constructs, conceptual frameworks and theories (Eisenhardt, 1989; Miles & Huberman, 1994; Yin,

2003), and cross-case analyses facilitate the development of testable propositions (Eisenhardt, 1989; Markus & Lee, 1999).

Qualitative data is collected through performing case studies and interviews, which enable a rich description and explanation of the "messy," fluid and subtle context of phenomena such as inter-organizational exchange and organizational behavior (Miles & Huberman, 1994; Parkhe, 1993). Qualitative data (e.g., those derived from semi-structured interviews) provide an improved understanding of the stories, events, reasons and natural context behind the studied phenomena, in the interviewees' own words (Miles & Huberman, 1994; Sykes, 1991).

3.2. Exploratory and confirmatory aspects case studies

It was planned to perform explorative case studies, followed by a confirmatory study. Therefore, this study contained exploratory elements at the beginning, and confirmatory aspects in the later cases studies. This study design is a common approach while performing case studies and combinations of quantitative and qualitative approaches (Miles & Huberman, 1994, p.41; Weitzenfeld, Riedl, Chubb, & Freeman, 1993). However, the confirmatory aspect only partially validated the framework concerning the inter-organizational properties. In addition, these case studies actually enabled a further exploration and specification of the basic preliminary framework on antecedents, as well as their use and effects.

3.2.1. Exploratory aspects case studies

Exploratory and descriptive case studies were performed for the following reasons:

- Contemporary theoretical approaches provide insufficient explanations of the use and effects of Internet-based tools. Therefore, there is a need to reassess, describe, explore, identify and specify the characteristics (properties, in this case) of inter-organizational exchange, as well as the use and effects of Internet-based tools. The loose design of exploratory case studies helps specify the unit of analysis in greater detail, in this case the use of Internet-based tools in inter-organizational exchange (Miles & Huberman, 1994, pp. 16-18).

- The inductive logic of exploratory case studies is highly suitable for researching understudied phenomena, as well as exotic cultures and industries (Miles & Huberman, 1994, p.17). The exploratory case studies were used to gain information about the differences between industry value segments within the recycling industry (e.g., the remanufacturing and recyclable material wholesalers). Further, the case studies help to identify product segments (e.g., scrap metals, paper and plastics) with the most diverse use of Internet-based tools. Industry segments using both communication and brokerage-like tools were considered for the sampling of confirmatory case studies.
- Industry-level analyses are rare, especially those with a focus on the recycling industry, strengthening the exploratory nature of the study. Further, we needed to describe and explore the characteristics of inter-organizational exchange such as transactions and selling activities. Also, there are only a few studies on the use and effects of Internet-based tools within the recycling industry.
-

3.2.2. Development of theoretical framework

Case studies can foster the development of theory (Eisenhardt, 1989; Yin, 2003). The possibility to adjust the design is based on emerging findings in the field (Yin, 2003, p.55). The exploratory case studies were based on a preliminary framework of the antecedent use and effects derived from e-market theories to “enable explicit theoretical explorations to elaborate on key conceptual issues within a previously identified broad subject area” (Yin, 2003). Case studies grounded in prior theory strengthen the design of the study and help to analyze of the empirical findings. The inductive logic of the case

study method is employed to explore, further specify and augment the constructs (Lee, 1999; Yin, 1994) associated with the properties of inter-organizational exchange (thus antecedents) and the use and effects of Internet-based tools, as well as the interdependencies between the exchange properties. The analysis of the exploratory case studies contributed to the development of the conceptual framework as presented in the theory review.

3.2.3. Influence of inter-organizational exchange properties

A series of confirmatory case studies (Miles & Huberman, 1994, p.41; Yin, 2003) were performed that were centered on recyclable material wholesalers of scrap metal, to confirm or possibly disconfirm the conceptual framework on the antecedents, use and effects of Internet-based tools. A deductive quantitative study was not conducted, since the exploratory case studies revealed that a survey of, for example, users of Web-based auctions within the recycling industry would not be feasible. One of the reasons was the limited number of registered auction sellers. The confirmatory case studies were guided by a higher level of prior theory in comparison to the exploratory case studies. A test was performed with the conceptual framework as discussed in the theory review, in which constructs and relationships were incorporated into a modified questionnaire.

The case studies enabled a confirmation of the influence of the inter-organizational exchange properties on the use and effects of Internet-based tools. However, the greater specification of the inter-organizational exchange properties, and the use and effects of

Internet-based tools, facilitated an unexpected exploration and interpretation of industry-wide dynamics and structures that could potentially improve the explanation of the variations in the use and effects of Internet-based tools. Therefore, a confirmation was only possible concerning the properties of inter-organizational exchange. The basic structure of the preliminary framework on the antecedent use and effects was disproved. Instead, a revised framework is proposed on the re-invention and social construction of Internet-based tools for further studies.

Switching from theory testing to theory building

The theoretical framework and its constructs on the use of Internet-based tools within the trading/exchange process were defined prior to performing any case studies. The theoretical framework enabled the researcher to specify the characteristics of inter-organizational exchange which influence the use and non-use of Internet-based tools. Such designs help researchers to enable “switching from theory testing research into theory building research by taking advantage of serendipitous findings” (Eisenhardt, 1989) (Bettenhausen & Murnighan, 1985).

3.3. *Unit and level of analysis*

The unit of analysis is the use of Internet-based tools within the context of inter-organizational exchange of recyclable materials occurring between recyclable material wholesalers and consumers of recyclable materials (Figure 13). Exchange may include transactions and activities concerning the trade of recyclable materials. The unit of analysis is studied through the perspective of individuals (e.g., managers and traders) working in firms selling processed recyclable materials. The unit of observation is the individual.

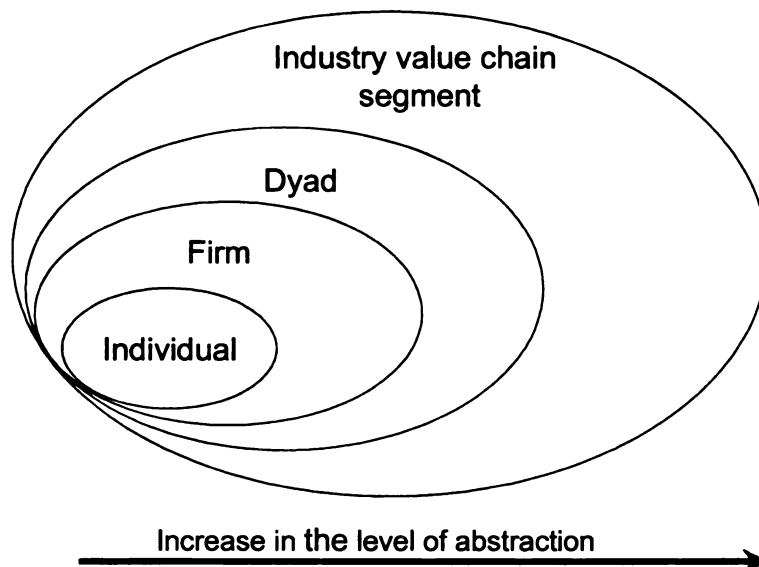
Figure 13: Unit of analysis: Inter-organizational exchange



The use and effects of Internet-based tools within inter-organizational exchange is studied at multiple levels of analysis such as the level of individual, firm, dyad (two firms) and industry (Figure 14). For example, corporate management may decide to implement specific Internet-based tools. Still, Internet-based tools are used at the individual level, and these individuals also make choices about usage. Studies on the level of single or multiple buyer-seller dyad(s) provide valuable insight. However, dyad studies have a greater likelihood to miss the influence of industry-wide structures, characteristics and

dynamics. Therefore, dyad studies are less suitable to study the type and extent of use, and the effects of Internet-based tools throughout the recycling industry. In addition, the exploratory case studies indicated that multiple recyclable material wholesalers trade with many firms, sometimes on an irregular basis. Studies incorporating an industry-wide perspective are very rare, with some exceptions (Bartley, 2003; Choudhury et al., 1998; Hoffman, 2001; Wigand et al., 2005). This study views inter-organizational exchange from an industry perspective. Individuals situated within a firm are the unit of observation. The case studies of multiple firms provide information on the industry-wide use and effects of Internet-based tools. An industry-wide perspective enables a study of, for example, the users and non-users of Web-based auctions. Auctions require multiple industry participants, and therefore an industry view is almost necessary to look beyond a single trade system.

Figure 14: Level of analysis



3.4. *Instrumentation*

3.4.1. *Construct specification*

Loose design

The earlier described contradictions between EMH and observations act as an argument for refraining from specifying the propositions about, for example, inter-organizational exchange properties, as well as the use and effects of Internet-based tools at the start of the exploratory case. In this stage, specific propositions could bias and limit the findings and reduce theoretical flexibility (Eisenhardt, 1989). Prior empirical research seems unable to present an integrated approach to understand the phenomena under study. Therefore, a relatively low level of prior front-end instrumentation helps to avoid the risk of forcing a preconceived model and explanations on the data, and overlooking or misinterpreting the data (Miles & Huberman, 1994, pp. 34-37). The interdisciplinary focus of this study (e.g., augmenting transaction costs theory with the social embeddedness perspective) reduces the risk of forcing comparison to studies with a singly theoretical perspective (Miles & Huberman, 1994, p. 38).

It is argued that researchers should work towards the highest level of construct specification (Eisenhardt, 1989). Therefore, a set of theoretical constructs were *a priori* selected and defined on the basis of a literature review of the antecedents (e.g., transaction attributes and social business relationships), use (e.g., auctions and email) and

effects (transaction costs only) of Internet-based tools. Constructs used in prior studies enabled a detailed specification.

However, inter-organizational exchange and the use of Internet-based tools were broadly defined. The reason being that the constructs describing inter-organizational exchange lack a thorough conceptualization, and as a result may have been too narrowly interpreted, or were potentially misinterpreted (Biggart & Delbridge, 2004). The theory review indicates that scholars insufficiently studied the constructs describing inter-organizational exchange itself, as well as the interdependencies among them. As a result, prior studies may have focused on too small a set of constructs, and therefore may have excluded crucial variables explaining the use and effects of Internet-based tools.

The exploratory case studies were performed to ensure that the set of constructs associated with the properties of inter-organizational exchange (antecedents), as well as the use of Internet-based tools were inclusive, and if necessary to specify ignored constructs and/or indicators (e.g., email and online real-time price services). The aim was to describe inter-organizational exchange in detail and explore how its characteristics influenced the use and effects of Internet-based tools.

A more loose design also enabled taking advantage of emerging issues, topics and serendipitous findings arising from the conducted case studies (Bettenhausen & Murnighan, 1985; Eisenhardt, 1989; Gersick, 1988; Yin, 1994). To do so, questions were incorporated to explore and identify other relevant constructs and interdependencies not

previously recognized, as well as to explore emerging issues. Case studies also increase receptiveness towards questions and answers among firm managers, traders and executives (Miles & Huberman, 1994, p.17). This is important due to the increased survey fatigue among firms, and in order to explore emerging issues.

Tight design

The framework was modified, since the exploratory case studies uncovered several constructs describing inter-organizational exchange, observing a more complex and diverse use of Internet-based tools. The next aim was to confirm/disconfirm this modified conceptual framework, namely the relations between the exchange properties (antecedents), the use and effects of Internet-based tools. Confirmatory case studies fit in the general positivist case study research strategy (Yin, 2003). To facilitate confirmatory case studies, constructs were more tightly defined and specific propositions were developed, as discussed in the theory review.

The tight design allowed a closer focus on the use of the individual tools themselves. Surprisingly and unexpectedly, the tight design enabled a further exploration and specification of the underlying logic of the preliminary and modified framework concerning the “antecedents, use and effect” perspective. The case studies contributed to a proposed second revision of the framework for further studies, also incorporating the theoretical perspectives on re-invention (Johnson & Rice, 1984) and social construction (Pinch & Bijker, 1987) of the use Internet-based tools.

3.4.2. Case study protocol

The questions formulated in the case study protocol stemmed from the constructs and relationships within the conceptual framework. Interviews focused on the exchange properties and the use and effects of Internet-based tools. The case study protocol guided the semi-structured interviews. Questions related to each construct and relationship were included in the questionnaire. The questions were specific enough to prevent managers from interpreting the questions in different ways, and to prevent difficulties in categorizing the answers (referred to as reliability). Further, transcriptions of the interviews were put into semi-structured form in MS Word. This document was exported to the NVivo computer program to help code the data used for further analyses (Richards, 1999). The use of semi-structured questions and the development of the case study database increase the reliability of the findings while reducing the complexities of conducting the case study interviews (Parkhe, 1993; Yin, 1994, 2003). Further, a letter of introduction was written to present and explain the purpose and content of the study. The letter indicated that the participants would be provided with a report of the study's findings.

Revision of the questionnaire

The initial questionnaire was redesigned after the analysis of the exploratory case studies of firms who exchange materials such as plastic, used paper and scrap metal. For example, questions were added to address the other identified properties of inter-organizational exchange, as well as their interdependencies. Also, existing questions were made more specific if necessary. The revised questionnaire was used to conduct

confirmatory case studies. The initial and revised case study protocols were reviewed by three professors of media and information studies.

3.4.3. Interview procedures

The semi-structured interviews were aimed to answer the exploratory research questions and to follow up on emerging issues during the interview. Most of the interviews were arranged offsite at, for example, the location of two conferences or by phone. A few interviews were arranged with the managers onsite at the firm location. Offsite interviews may avoid biases generated by the site location (e.g., exoticism) (Miles & Huberman, 1994, p.266). The interviewees were asked first to describe the nature of exchange, trading activities, the selling of recyclable materials, transactions, etc. Questions about the use and effects of Internet-based tools were often asked later in the interview. This technique was applied to gain more information on exchange, but also because during the initial case studies it became clear that the term 'e-business' created a lot of controversies.

The interviews had the form of a natural conversation. The interview protocol was from time to time consulted to check whether the different questions were being asked and answered. A number of interviews were taped, according to the permission of the interviewees. The written notes and tapes were transcribed. The interviews lasted from fifteen minutes to upwards of three hours, with an average of 25-30 minutes. Only a few conversations with firm managers and traders at the conference were shorter than fifteen minutes. During the shorter interviews there was no allowance for going into the details of each specific question. However, interviewees tried to answer the majority of the

questions. These short interviews focused on what managers thought about the use and effects of Internet-tools (brokerage-like tools were almost unanimously referred to as e-business tools).

Wholesalers/processors were asked about the used several Internet tools such as email and auctions. Oftentimes, wholesaler/processors mentioned that they were not using auctions, or had stopped using them because it did not fit their way of doing business. Wholesalers were then asked to explain why they did not fit their way of doing business. Prior to the interview, information related to the interviewed firm was collected. Information resources included the trade press, newspaper articles, literature, homepages and Internet sources, located through Internet searches on the firm's name. However, the interviews conducted during the conferences often did not allow the collection and study of information on the firm in advance. Whenever possible, firm brochures, PowerPoint presentations and other information available on the firm were collected after the completion of the interviews. Case studies were written based on the interview data and the aforementioned sources.

3.5. *Sampling strategy*

3.5.1. Selection of recyclable material wholesalers

The literature review indicated a relatively low use of Internet-based tools among firms within the recycling industry. The industry from which the case study firms are sampled should be as narrowly defined as possible, to control for industry variations. An industry selection also helps to define the limits for generalization of the findings (Eisenhardt, 1989). The selected industry value segment is the so-called recyclable material merchant wholesalers, defined by the US Census Bureau with NAICS code 421930/423930. Recyclable material merchant wholesalers process and trade recyclable materials of different varieties. Recyclable materials can be unprocessed, semi-processed or fully-processed and ready-for-consumption. The initial exploratory case studies focused on the three largest product markets, namely scrap metals, used paper (fiber) and recycled plastics. Recyclable material wholesalers process both post-industrial as well as post-consumer materials. These three markets are the three largest product segments as measured by sales (Beck, 2001; Porter, 2002).

The industry value segment recyclable material wholesalers is selected for the following reasons. First, there is a relatively large amount of recyclable material processors who are actively involved in trade and exchanges. In comparison, consumers of recyclable materials form a relatively more concentrated market, with fewer market players. Second, the boundaries of recyclable material wholesalers are already defined. By contrast, the

industry boundaries of consumers of recyclable materials are not well defined, since they often belong to multiple industries, such as the steel or paper industry. More importantly, consumers of recyclable materials often use both recyclable and virgin materials as their feedstock, which complicates the selection of the firms and responsible managers, therefore complicating the interviews and generalization of the findings.

The selected industries also differ in terms of the time materials were collected and trade was established. For example, scrap metal trade has existed for hundreds of years, whereas the market for recycled plastic only started to take off in the seventies and eighties (Ackerman, 1997; Porter, 2002). The inclusion of multiple recycling industry segments allows for the acquisition of knowledge and information of how the industry segments differ in the use and effects of Internet-based tools, and the factors influencing the uptake of Internet-based tools.

3.5.2. Multiple case study design

To perform the explorative case studies, a multiple case study design was employed to select firms in the paper, plastic and metal product markets within the recycling industry. In addition, businesses were interviewed in the remanufacturing industry. Multiple case studies are in comparison to single case studies more rigorous, provide more convincing evidence, and increase confidence in the findings (Firestone, 1993; Miles & Huberman, 1994, p.29; Yin, 2003, p.46). Also, multiple case studies allow cross-case comparison which strengthen the precision, validity and stability of the findings (Miles & Huberman, 1994, pp.29-35). The multiple case study design was also used for the confirmatory case

studies, but in this case only firms situated in the ferrous and non-ferrous metals market were selected.

Users and non-users

Both the exploratory and confirmatory case studies included users and non-users of different types of Internet-based tools. For example, firms may have used email but not Web-based auctions. Selecting users as well as non-users provides a more solid and comprehensive view of the factors influencing a firm's decision to use or not use Internet-based tools, as well as its experience or anticipated effects. For both users and non-users the multiple case study design is used.

Embedded case studies

Occasionally, the opportunity arose to interview multiple people in a single firm, which is referred to as "multiple case embedded design" (Yin, 2003). Multiple case embedded design implies that multiple units of analysis are used to assess one single case study. This strategy is also referred to as "within case sampling," in which the cases are nested within each other (Miles & Huberman, 1994, p.29). For example, I performed an interview with the director and sales manager of a scrap metal processor and wholesaler, as well as the director and sales manager of a firm managing a Web-based auction within the scrap metal industry. The analyses of the multiple interviews within a firm indicated that the content of the interviews was complementary, and did not identify any contradictions or different views on related issues.

3.5.3. Replication logic

Replication logic is used to select and perform the multiple case studies. Replication logic differs from sampling logic in that cases are selected based on theory, and do not necessarily reflect the selection of a specific subset of the population. Replication logic assures that case selection is based on the expectation of similar results (referred to as literal replication), or that cases are expected to produce contradicting findings (referred to as theoretical replication) (Yin, 2003)⁴¹. Literal and theoretical replication strategies are both applied because of the selection of both users and non-users of Internet-based tools. The use of the replication logic strengthens external validity (Yin, 1994).

The replication procedures build upon the preliminary theoretical framework to specify which particular phenomena are most likely to occur, or when it is likely that a contrasting result can be found (Yin, 2003). The exploratory multiple case studies were performed to guide the interviews and assert the model, to ascertain if the study addressed the right questions and focused on the proper critical constructs.

Information is always purposively or non-purposely collected while performing exploratory and confirmatory case studies. After a series of exploratory interviews, the analyses of the collected information were confronted with the framework guiding the case studies. The analyses provided arguments to modify, adjust, refine or further specify

⁴¹ <http://www.sis.uncc.edu/~seoklee/Projects/CSM.htm>

the framework and research questions, which is quite common in case study research (Yin, 2003). Such modifications should be reflected in an adjusted questionnaire. The series of interviews conducted for the purpose of performing confirmatory case studies were also analyzed, which enabled confirmation of the inner workings of the inter-organizational exchange properties, and indicated a need for a further specification of the framework.

3.5.4. Sampling parameters

To ensure that the study is open to the “iterative aspects of multiple case sampling, an explicit sampling frame is needed” (Miles & Huberman, 1994, p.29). The sampling parameters to perform multiple case study should be derived from the conceptual framework and research questions (Miles & Huberman, 1994, p.30). Information about the settings, actors, events (e.g., auction usage) and processes (e.g., trading activities) must be collected. Qualitative samples are more likely to be purposive than random (Miles & Huberman, 1994, p.27). The selection of case studies guided through the logic of theoretical sampling is chosen for theoretical, but not statistical reasons (Glaser & Strauss, 1967). The cases are chosen to replicate previous cases, to fit theoretical categories and provide examples of polar types (Eisenhardt, 1989). The sampling is therefore driven by conceptual questions, instead of issues of representativeness, as is the case with random or statistical sampling (Glaser & Strauss, 1967; Miles & Huberman, 1994, p.29).

The sampling strategies used in this study were based on the typologies for qualitative research strategies (Miles & Huberman, 1994, p.28). First, theory-based or theoretical sampling was applied since the selected firm fit the theoretical framework. Second, opportunistic sampling was applied, since we interviewed firms during visits of two conferences where managers could be asked directly if they were willing to participate in the study. Third, convenience sampling was also applied. For example, when business managers were met at the dinner table, they were asked if they would be willing to participate in the study and talk about the trade of recyclable materials.

3.5.5. Qualifying criterion and case selection

The study was confronted by several constraints. First, studies of corporations are faced with the increasing reluctance of business people to participate in an academic study. Therefore, selecting a firm may not always result in an interview. Second, even if firms are willing to cooperate, the interviewees may have only limited time available. The interviews may differ in length depending on the time available to managers, and thus also differ in the level of detail.

3.5.6. Overview of targeted organizations and firms

Selection criteria for exploratory case studies

- First, **academic experts** were selected and contacted, based on their knowledge in the field of recycling and environmental economics, as well as their involvement in studies focusing on recycling-related issues. Academics were contacted to discuss recycling-relevant issues regarding the use of Internet-based tools. These interviews enabled refinement of the questionnaire, concerning the specific and general challenges faced by the recycling industry.
- Second, **industry informants** were contacted to get an insider's view of the recycling industry and its challenges, and to have a critical and longitudinal overview of the general issues faced by the recycling industry. One of the informants was a waste manager at a large Midwestern university and had performed committee work for the National Recycling Coalition, Inc. (NRC)⁴². The local informant also recommended talking to specific people and firms (according to the manager's informed judgment) that would be able to represent the particular challenges faced by the recycling industry.
- Third, it was decided to attend two **conferences** on recycling issues in the State of Michigan to become more acquainted with the recycling industry, and to come in

⁴² The NRC is a nonprofit organization founded in 1978 with 4,500 members committed to maximizing recycling. Members include recycling and environmental organizations, large and small businesses, federal, state and local governments, and individuals (<http://www.nrc-recycle.org>).

close contact with business people. The first conference attended was the 11th Annual Waste Reduction and Energy Efficiency Conference and Expo, Great Lakes Region on November 5, 2003, at Livonia, MI (<http://www.michigan.gov/deq>). This conference had a regional character and was in close geographical proximity to the researcher working location. The second conference attended was the Global Plastics Environmental Conference (GPEC 2004) organized by the Society of Plastics Engineers (SPE) on February 18-19, 2004 at Detroit, Michigan. The selection of the second conference was based on the product market segment, namely plastics recycling. Interviews were performed with different market actors in the value chain for recyclable materials, such as generators, remanufacturers, processors, wholesalers, dealers/brokers, consumers (e.g., paper and steel mills), government officials, policy makers and industry experts.

- Fourth, interviews were performed with the managers of three different **brokerage-like Internet-based organizations** in the recycling industry. The studied brokerage-like Internet based tools can be categorized into two groups, namely a) online initiatives which facilitate the aggregation of supply and demand and b) Web-based auctions which enable bidding at an auction. In the first, the initiatives consist of directory of posting of firms indicating that they are willing to buy or sell particular recyclable materials, while email services are used to match buyers and sellers in the second. Three interviews were conducted, including a government-run/supported Internet exchange, an online demand & supply aggregator, as well as a matchmaker for almost any possible recyclable material. Also, an exploratory interview was performed with a Web-based auction for scrap metal. The criteria to select these

brokerage-like Internet-based firms were that these initiatives would be established for more than two years to make sure I did not interview a firm which was more a business idea or startup instead of a company, and therefore had experience for a longer period. Brokerage-like Internet-based tools, which have been established for quite some time, are also more likely to have solved any technology-related problems, and probably have a value proposition, which attracts customers. Firms who continue to make use of these brokerage-like firms are also more likely to perceive or notice real benefits of its use.

- Studies suggest that industry associations can be instrumental in promoting the use of brokerage-like Internet-based tools. Therefore, the perspective of the industry association could indicate general perceptions towards trading recyclable materials and the use of Internet-based tools. An interview was conducted with an associate of one of the major **industry associations**, which had the most members in the targeted industry segment and product market.

Selection criteria for confirmatory case studies

To perform the confirmatory case studies the following interviews were performed. The criteria were that these firms would be active in national and/or international markets, and, if possible, would be a member of one of the main industry trade associations, such as ISRI.

- First, three interviews were performed with the director of a Web-based auction of scrap metal. The interviews provided a large amount of information, such as industry characteristics, the experiences of buyers and sellers, the motives to participate as well as the inner workings of the auction.
- Second, it was decided to attend the annual Commodities Roundtable Forum organized by the Institute of Scrap Recycling Industries Inc. (ISRI),⁴³ September 21-23 in Rosemont, Illinois (Chicago area). This conference is a nation-wide forum for recyclable wholesalers in the United States, Canada and Mexico, designed to provide, for example, the chance to socialize and meet new business partners. At the conference I was able to learn from the presentations, socialize with the industry people and even perform interviews with business people, firms, exhibitors and sponsors.

⁴³ ISRI, which roots dates back to 1913, represents more than 1,200 companies that process, broker, and consume recyclable materials such as metals, paper, plastics, glass, rubber, electronics, and textiles.

- Third, both during and after the conference interviews were conducted, the firms were actively selling scrap commodities at the Web-based auction. On the website of the auction successful closed auctions could be viewed, which enabled the researcher to make an informed judgment on whether or not firms were actively involved. Three firms were interviewed which were actively selling on the auction. One firm interviewed at the conference was recommended by the director of the Web-based auction. The other two interviews were conducted by phone.
- Fourth, during and after the conference recyclable material wholesalers were interviewed who had not yet used the **online auction**. However, these firms were still using other Internet-based tools, as became clear during the course of the interviews.
- Fifth, during and after the conference firms were interviewed which had previously participated in the Web-based auction, but currently were no longer using it. If possible, firms were interviewed that were members of the main industry association, since these firms are more likely to be established and respected businesses, in comparison to non-members.
- It may seem that the majority of interviews were conducted with firms located in the Midwest. The reason is twofold. First, recycling industries in the US are concentrated in the Midwest (US Census, 2002). For example, one of the largest recycling companies in the US is the David J. Joseph Company (DJJ), whose headquarters are in Cincinnati, Ohio. Therefore, the locations of the interviewed firms do not necessarily suggest a bias towards the location of the researcher's university. However, it is acknowledged that contacting firms located in the Midwest would

more likely result in managers agreeing to participate in the study. This could be due, for example, to a relatively higher name recognition of the university in the region.

Appendix A, B, C and D contains a table with the basic indicators of the interviewed firms, as well as a more detailed description of each.

Person selection

Interviewees were selected based on their close involvement with the trade of recyclable materials. Interviews were sought after with the individual who was most familiar with the day-to-day operations of the business concerning the trade of materials. Sometimes this individual was the owner of the business, but more often it was the trader or sales manager. For example, firms contacted by phone were kindly asked to transfer the researcher to the person who was managing or involved with the trade of recyclable commodities. The interviews were mostly conducted with a trader, manager or director of a firm. Since many recyclable wholesalers are SMEs, this was expected. It was noticed that traders provided a bit more detail about the specifics of the trading activities in comparison to the managers and directors. Although the function of the interviewees and degree of detail was to a certain degree heterogeneous, we did not experience any problems to compare the cases. For example, in three cases interviews were conducted with two persons working for the same firm, who worked at different functional levels in the organization. The data of the results were similar and only varied in the level of detail related to inter-organizational exchange and the specific uses of Internet-based tools.

3.6. *Analytical strategies*

Analytical strategies assist researchers in the ability to perform a fair judgment of the collected data, to provide convincing analytic conclusions, and to exclude alternative interpretations (Yin, 2003).

3.6.1. Description and interpretation

The data description in Chapter 5: Findings makes use of quotes from the interviews to illustrate the theoretical issues raised by the propositions (Carson, Gilmore, Perry, & Gronhaug, 2001, pp.196-197). Quotes are used for illustration purposes but “also embody vividness that brings the points alive in a way that evokes the human interest of the readers” (Golden-Biddle & Locke, 1997, p.68). Quotes were used as examples derived from the case study transcriptions in the case study database. Grammar style and wording of the quotes avoided as much as possible to avoid any researchers own interpretations. If interviews were not recorded, the written notes were used instead.

The quotes were derived from the coded qualitative data which is the assignment of labels to different parts of the textual data (Miles & Huberman, 1994). The codes followed the specific constructs of the conceptual framework. Also, issues were coded which were not covered by the framework. The findings focuses on the confirmatory case studies and therefore makes predominantly use of the data and quotes from the interviews with the recyclable material wholesalers, the Internet ventures and industry association representative.

The interpretation of the data enabled the support or rejection of a proposition. It was decided to sustain or corroborate a proposition if the data from the interviews (thus coded quotations and text) indicated consensus and similar meaning among two or more wholesalers (Carson et al., 2001, p. 196). Sometimes, theoretical issues were mentioned only during one interview, which provided indications that the propositions were only minor supported/sustained. Further, we searched and coded data, which indicated divergent or contradictory opinions among wholesalers concerning the use and effects of Internet tools. The occurrence of contradictory opinions provided indications that a proposition was only partly supported or rejected. Indications to reject a proposition were based on those situations in which the interview data lacked support or lacked any mentioning by wholesalers (thus coded data).

3.6.2. Exploratory case studies

The analytic strategy for the exploratory case studies was to develop a case description and to develop rival explanations (Yin, 2003) p109-116. Formulating propositions at the beginning of the study is not recommended, since it may bias a researcher's interpretation and data collection (Eisenhardt, 1989). Instead, this dissertation study started by developing a broad theoretical framework, then introduced several research questions to guide the data collection through performing exploratory case studies.

Cross-case synthesis and comparison

The analytical technique of cross-case synthesis and comparison (Miles & Huberman, 1994; Yin, 1994) can be used since the multiple case study design enables a more narrow design (Miles & Huberman, 1994, p.35). The examining, categorizing, tabulating and testing of the qualitative evidence (Yin, 2003) was confronted with the initial theoretical framework and research questions. The analysis therefore resulted in a descriptive framework for structuring the cases. The analysis of the exploratory cases identified inconsistencies and emerging themes. This resulted in an augmentation, specification and modification of the framework, and the development of several propositions. Both were tested in the later confirmatory case studies. There are some limitations of the case study method. First, it is argued that case studies have the risk of generating theories which are narrow (Eisenhardt, 1989). To counter this concern we performed exploratory case studies while recognizing the limitation of the initial framework used, based on an extensive literature review. Second, case studies run the risk of generating quite complex theories (Eisenhardt, 1989; Parkhe, 1993). Therefore, we guided the case studies by the original research questions (Eisenhardt, 1989) and constantly kept in mind the original study goal (Yin, 1994).

3.6.3. Confirmatory case studies

After performing a series of exploratory case studies, two additional complementary behavioral assumptions were added to the theoretical framework, to guide the subsequent series of confirmatory case studies. These added theoretical assumptions on organizational behavior are cooperation and the evolutionary perspective on the interdependencies between the inter-organizational properties. The confirmatory case studies included several propositions related to the derived antecedents related to the complementary behavioral assumptions.

The analysis of the confirmatory case studies enabled the development of a case description, and relied on theoretical propositions from the modified conceptual framework (Yin, 2003). Unexpectedly, the analyses also enabled the development of a rival explanation to further specify the already modified conceptual framework (Yin, 2003) p109-116. Inductive logic was used in an effort to confirm the validity of the modified conceptual framework and introduced propositions (Lee, 1999; Yin, 1994).

Three analytical techniques are used to analyze the exploratory case study data, namely cross-case synthesis, pattern matching, and explanation building (Yin, 2003). First, cross-case study synthesis is explained above. Second, pattern-matching is used to compare the observed pattern with the predicted pattern of independent and dependent variables. Pattern-matching can uncover the alternative patterns derived from the rival proposition (Trochim, 1989; Yin, 2003, p.116). Third, explanation-building analysis is guided by the propositions, which are confronted with the collected data (Yin, 2003). Propositions

enable a tighter design, which will increase the sophistication of the data analysis supporting an explanatory strategy. Explanation-building is an iterative process, which includes a series of steps to increase the confidence in the findings (Yin, 2003, pp. 120-122). These steps enable a further refinement of the framework and propositions (Yin, 2003). Initially, the data is confronted with the initial propositions and revised framework, leading to their possible revision. Afterwards, other case study findings are compared to the modified propositions and framework to determine the possible need for further revisions (Yin, 2003). Researchers need to make constant reference to the purpose of the study, in order to avoid wandering away from the original topic of the study, framework and propositions (Yin, 2003).

The examining, categorizing, tabulating and testing of the qualitative evidence collected from the confirmatory cases (Yin, 2003) was confronted with the redesigned theoretical framework and theoretical propositions. Conclusions can be asserted to the extent to which the data categories fit the propositions (Glaser, 1978; Miles & Huberman, 1994). The conclusions can be generalized to theory.

The analysis of the confirmatory case studies provided two results. First, the inter-organizational exchange properties were confirmed. Second, a second revision of the framework is proposed. The analysis of the confirmatory analysis indicated the need for another augmentation of a complementary theoretical approach, based on the social construction of technology or, more specifically, the structuration of technology use. The

augmentation enabled a further specification of the basic underlying antecedents use and effects framework.

3.7. *Quality of the case studies*

Many precautionary measures have been taken, to make sure that the collected evidence would improve the quality of the study.

Construct validity

To safeguard the construct validity of the case study information, the following measures were taken (Yin, 2003, pp. 33-39): a) usage of multiple sources of evidence, b) establishing a chain of evidence (Yin, 2003, pp. 33-39) and c) performing exploratory interviews with little prior instrumentation, as discussed earlier (Miles & Huberman, 1994). The collection of multiple sources of evidence strengthens the validity of constructs, theoretical framework and propositions, since it is possible to triangulate⁴⁴ the data from the conducted interviews, along with data/information collected from other sources (Eisenhardt, 1989; Yin, 2003). Multiple sources may indicate a convergence of evidence.

Three sources of evidence were collected, namely the interviews conducted with firms in the recycling industry, the information collected from documents relating to interviewed firms and finally the use of firm databases. Documents were collected from multiple sources, such as homepages of the firms, brochures, press releases, annual reports, trade

⁴⁴ Four kinds are distinguished, namely data, investigator, theory and methodological triangulation (Patton, 1987; Yin, 2003, pp.97-101).

press reports, newspaper articles, literature and general Internet searches on recycling firms and industry key words. The collected documents often lack in-depth coverage of the trading activities of recyclable materials and the use and effects of Internet-based tools. The online database of the ISRI, as well as the North American Scrap Metals Directory provided other characteristics of the firm, such as detailed listings of products.

These three sources of evidence have their respective strengths and weaknesses. First, interviews can be targeted and insightful. However, interviews may have a “bias, because of, for example, poorly constructed questions, response bias, inaccuracies due to poor recall, reflexivity, interviewees giving what the interviewer wants to hear” (Yin, 2003). The following actions were taken to strengthen the study: the questionnaire was reviewed by experts on information systems and recycling; the response bias was reduced by introducing semi-structured and open-ended questions; the researcher invited the interviewees to describe, in their own way, how recyclable materials were treated, and they were asked to talk freely about trading activities, processes, procedures, tactics, strategies, negotiations and closing a deal, all with or without the use of Internet-based tools. The interview focused on trade activities and the research issues were brought into the conversation as neutrally as possible. Furthermore, questions focused on the positive and negative effects of Internet-based tools, to avoid a specific bias. Also, the interviews were taped only when permission was granted. Taping and transcribing interviews reduce the effect of poor recall. Field notes and recalls were used to write up any unrecorded interviews. All write-ups and transcripts were semi-structured, organized in a MS Word document. Second, the advantages of using documentation are their stability,

unobtrusiveness, exactness and broad coverage. However, the weaknesses are, for example, retrievability, biased selectivity, reporting bias by the author and problems of gaining access to internal documents. The documents were critically examined and compared to strengthen the study. Third, the databases only provided limited but nevertheless useful information. Information from the databases was compared to the other sources to check for inconsistencies.

The chain of evidence should enable the reader and other researchers to logically and unambiguously follow the rationale behind the arguments (Yin, 2003). For example, it should be possible to trace back how the conclusions are derived, from the semi-structured database of the collected data of the case studies, to the citations of evidence in the text; to questions in the case study protocol and eventually back to the research questions.

Convergent and discriminant validity

Construct validity implies the extent to which two constructs or indicators (observed items) are related to each other. Since we are not performing a quantitative study, we can not assess the patterns of the correlation coefficients. To assess convergent validity, it is necessary to show that the items or indicators of constructs are in reality related to each other. Discriminant validity assesses the extent to which supposedly unrelated indicators or items are in reality related to each other. To assess discriminant validity, then, the indicators/items of two or more different construct should not closely correlate with each other.

Internal validity

To safeguard internal validity, the data analysis will perform pattern-matching, explanation-building, cross-casing and assess the need to introduce rival explanations (Yin, 2003).

External validity and generalization

The use of the triangulation and replication logic will increase the confidence in the external validity of the study (Yin, 2003, pp. 33-39). Case study results are generalized to a broader theory (“analytical generalization”), instead of statistical generalization to populations (Ragin & Becker, 1992; Yin, 1993, p. xiii). A limitation is therefore that findings are difficult to generalize to be directly applicable to other industries. Some evidence supporting a theory is sufficient to perform analytical generalizations, but definite proof is not necessary (Firestone, 1993). Last, we recognized that quantitative studies are needed to further validate the theoretical framework. We originally planned to perform such a quantitative study, but the emerging findings enabled us to make a larger contribution to theory development. Also, the number of sellers at the studied Web-based auction was still too small to perform a quantitative study. As a result, this study provides only a limited understanding of the relative importance of the factors examined

Reliability

The development of the case study protocol and the semi-structured case study database were developed to ensure the reliability of the findings (see also paragraph 3.4.1.)(Yin, 1994).

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 02736 8970

139

362

THE

816

LIBRARY
Michigan State
University

PLACE IN RETURN BOX to remove this checkout from your record.
TO AVOID FINES return on or before date due.
MAY BE RECALLED with earlier due date if requested.

DATE DUE	DATE DUE	DATE DUE
OCT 27 2007		

**EXPLAINING VARIATIONS IN THE USE OF THE INTERNET TO SUPPORT
INTER-ORGANIZATIONAL EXCHANGE:
THE CASE OF THE RECYCLING INDUSTRY**

VOLUME II

By

Thomas Adelaar

A DISSERTATION

**Submitted to
Michigan State University
in partial fulfillment of the requirements
for the degree of**

DOCTOR OF PHILOSOPHY

Department of Telecommunications, Information Studies and Media

2005

4. FINDINGS

Recyclable material processors use communication-like tools such as real-time data feed services, email (including wireless email), and brokerage-like tools such as auctions. This chapter predominantly presents the findings of the explanatory case studies which are described in greater detail in Appendix A, B, and C. There also occur sporadic references in the text to the exploratory case studies which are presented in Appendix D. Readers may refer to Appendix E for the nature and specifics of recyclable materials. This chapter begins with an overview of the value chain of the recycling industry.

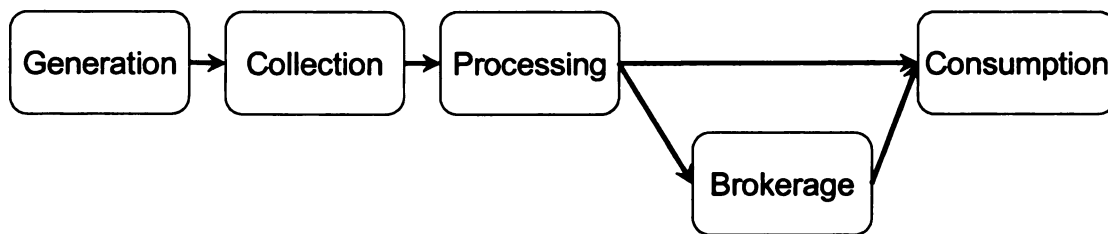
4.1. *Case background: Value chain analysis of the recycling industry*

The exchange of recyclable materials can be analyzed in various dimensions. First, we discuss the various industry segments within the recycling value chain, to better understand the context of the selling of scrap metals by recyclable material wholesalers. Second, we discuss the factors influencing the prices of scrap metals, such as the reference prices established at future and commodity exchanges. Third, a discussion follows of the different negotiation phases for selling recyclable materials, this being the main price discovery mechanism in the recycling industry. Fourth, we discuss the way institutional elements, such as grading standards, influence the trading of recycled

materials. Finally, we discuss the crucial role of business relationships within the trade of recyclable materials.

Recycling consists of a set of general activities, namely generation, collection, processing, brokerage and consumption (Figure 15). Materials move from one activity to the next through trade. The activities are the basis of the different industry value chain segments. They may occur in a single firm through vertical integration. For example, a processor may collect the materials directly from the generator. Also, it is often observed that processors perform brokerage activities (Interviews). Below each activity is discussed in detail.

Figure 15: Value chain of the recycling industry: A process view



It is estimated that the total US recycling industry (excluding the reuse and refurbishing industry) has an annual revenue of \$222 billion, consist of 30,000 establishments, and employs 950,000 people (Beck, 2001; NERC, 1998) (Table 2). However, data about the recycling industry is scarce. However, studies sometimes differ in the reported data, due to differences in definitions and measurement procedures. For example, data gathering is

complicated since generation and consumption are categorized across multiple industries, coupled with the fact that these industries use both primary and recyclable materials.

It is therefore not surprising that studies of the US Census Bureau, US Geological Survey differ in their data reports compared to other studies, such as the government-supported study by Beck (2001) and data provided by industry associations. For example, the throughput of various types of recyclable materials as well as number of establishments and sales differ across the studies. Further, ISRI estimated the throughput ferrous metals on 62.1 million tons, whereas the study of Beck estimated the throughput on almost 70 million tons (Beck, 2001). Studies of government agencies are selected as the main source whenever possible (e.g., data on recyclable material processors/wholesalers) unless otherwise mentioned.

Table 2: Value chain for recyclable materials by industry sector

	Collection	Processing & brokerage (c)	Consumption/ Manufacturing	Industry total
Establishments	9,247	12,051	8,047	29,345
Employment	32,010	160,865	759,746	952,621
Annual payroll (a)	956,875	3,826,360	29,181,749	33,964,984
Estimated receipts (a)	1,974,516	41,753,902	178,390,423	222,118,841
Estimated throughput (b)	191,082	191,082	157,545	539,709
Receipts / Employment	62	260	235	233
Receipts / Establishments	214	3,465	22,169	7,569
Annual payroll / Employment	30	24	38	36
Receipts / Throughput	10	219	1,132	412
Share of total industry	0.9%	18.8%	80.3%	

Source: (Beck, 2001)

Notes:

- a) “Annual payroll and estimated receipts are in \$1,000” (Beck, 2001).
- b) “Throughput is in thousands of tons. Throughput is amount of recovered material recycled and includes manufacturing scrap sent for recycling” (Beck, 2001).
- c) The study by Beck (2001) did not differentiate between processing and brokerage.
- d) Throughput is amount of recovered material recycled and includes manufacturing scrap sent for recycling.

The recycling industry segments enable the fundamental transformation of recyclable materials into newly-manufactured products. However, the degree of transformation differs across the three major industry value segments. Collectors gather, sort and aggregate materials. Processors sort, crush, dismantle, densify, etc. materials. However, the major degree of transformation of materials takes place within the consumption/manufacturing phase. The difference in the degree of transformation of materials is reflected in the industry share of the three major industry segments. Sales of collection activities only account for 1 percent of total industry sales/receipts, processing account for about 19 percent of total industry sales, whereas consumption/manufacturing accounts for the remaining 80 percent of industry sales (Beck, 2001) (Table 2). When materials move up through the recycling value chain from generation, to collection, to processing and finally to manufacturing, we see that the size (sales and employees) of the industry increases. The reason is that each industry value chain segment adds more value

to the recovered material, in comparison to the activities performed beforehand (Beck, 2001).

4.1.1. Generation of scrap

There are three forms of scrap, namely home scrap, new scrap and old scrap. Home scrap is generated as a by-product of the operations of industries manufacturing products from virgin commodities such as steel mills, paper mills and plastics. The chemical composition and physical conditions of home scrap are well-known, which in most cases enables the direct in-house recycling. Over the last decade, the increased efficiency of operations has greatly reduced this type of scrap. New scrap (also referred to as pre-consumer or prompt scrap) originates from “the many stages of industrial processing and manufacturing that precede an end product” (USGS, 2003a). For example, residual materials generated from a plant producing steel products, in the form of trimmings, cuttings and off-specification materials or products (Interviews MI AL). Generators are located in many different industries and they can also produce many different types (e.g., non-ferrous and ferrous metals), qualities and quantities of scrap.

Generally, scrap generated from pre-consumer sources has a higher and more consistent quality (less impurities, better materials), forming a more predictable and larger supply, in comparison to post-consumer scrap. Due to the high quality and consistent and relatively large supply, collectors and processors seek to establish long-term contracts with the generators. For example, collectors as well as processors often try to raise awareness among generators about the optimal procedures to perform the initial sorting of the

materials (Interviews). Recycling firms can also provide the necessary means (e.g., specific containers and pick-up services) to optimize and streamline collection at the source (Interviews). Generators need to capture and sort the recyclable materials generated from production processes, then try to find a market for their products and obtain the best price. Increasingly, generators award contracts by auction to the highest bidder (Interviews).

Old scrap (also referred to as post-consumer or obsolete scrap) is generated from used products, which become available through demolition projects, disposal of appliances or the collection of plastic bottles and corrugated boxes (Interviews). For example, metals and plastics account for 16 percent of the 200 billion pounds of municipal waste generated annually in the United States (Gale & Group, 2001).

The amount of generators in a region, such as manufacturers and major concentrations of populations, influences the supply of recyclable materials (Roy, 1998). The increased efficiency of production methods and a reduction of manufacturing activities in the United States over the last 40 years resulted in a reduction of the supply of new scrap. On the other hand, there was an increase in recycling rates of communities and firms (the amount of recovered recyclable materials from the waste stream) due to state and local policies, as well as private initiatives (e.g., the recycling of cell phones). The increase of the recycling rate has resulted in a greater availability of unprocessed recyclable materials, such as old/obsolete metal scrap (Sieling, 1990).

Furthermore, the supply of metal scrap is dependent upon the import and export of recyclable materials. Supply also depends on the prices of scrap. Scrap supply tends to increase when prices are relatively high. High prices increase the incentives to bring materials into the marketplace (recycling rate). However, when prices tend to be low, supply also tends to lower. Collectors may not collect material and processors will increase their inventory as a cushion for low prices.

4.1.2. Collection

Collection involves the sorting and aggregation of recyclable materials. Collection is performed by, for example, peddlers, processors, recyclable material wholesalers, municipal and private collectors, material recovery and composting facilities (PA-DEP, 2005). Collection activities employ more than 3.2 million people in the United States with a payroll of \$95.7 million and annual sales of \$1.9 billion (Beck, 2001). Collectors who consolidate recyclable materials add only a relatively low amount of value. Collectors may gather multiple varieties of recyclable materials (e.g., paper and plastics, or a variety of metals), while others may specialize in certain types of materials (e.g., aluminum or copper).

A study performed by Beck shows that the collection industry consists of 9,247 establishments, employs 32,010 people, and has gross sales of more than \$1.9 billion annually (Beck, 2001). The collection industry has a relatively low sales per employee rating (\$62,000) and a relatively small rate of turnover per establishment (\$214,000) (Beck, 2001). A few big firms dominate the collection industry (e.g., Waste Management), whereas the majority of the firms are relatively small (e.g., peddlers). For example, the size of the receipts is relatively low in comparison to the throughput, namely \$10,000 per ton. This provides an indication of the relatively low value per tonnage of recovered material. The added value of collection is relatively low since the materials are not processed, only being collected and sometimes sorted and aggregated.

4.1.3. Processing

Recyclable material merchant wholesalers have the scrap processing facilities to collect, sort, aggregate, densify, process, grade and customize a large variety of scrap materials for wholesale distribution to recyclable materials (Fenton, 1998). For example, processors dismantle motor vehicles with sophisticated machines with the aim to wholesale the scrap (www.census.gov). However, recyclable material wholesalers often do not alter the fundamental state/composition of the recyclable materials.

The US Census Bureau categorizes the processing industry as so-called recyclable material wholesalers with NAICS⁴⁵ code 421930 (Census, 1997). “Recyclable materials often take title to the goods they sell, meaning that they own the materials they buy and sell” (Census, 1997). They sell new or used durable goods with a life expectancy of more than three years. In 1997, the industry segment representing the recyclable material wholesalers consisted of 9,088 establishments in 1997, generated almost \$39 billion in sales, employed almost 115,000 people and processed more than 190 million tons of recyclable materials (Beck, 2001; NERC, 1998; U.S.CensusBureau, 2004b) (Table 3).

The realm of recyclable material wholesalers is a growing industry, having grown from \$24 billion total sales in 1992 to \$38.7 billion in 1997 (Table 3). Increased recycling efforts contributed to this growth. However, after 1997, the recycling rates for many

⁴⁵ North American Industry Classification System

recyclable materials have leveled off, or in some cases declined, as is the case with aluminum Used Beverage Can (UBC). In 2002, the US Census Bureau changed the classification scheme substantially (NAICS 2002 vs. NAICS 1997)⁴⁶. Therefore, available information on the recyclable wholesalers industry for the year 2002 is hard to compare with the data from 1997 and 1992. For example, revised classification sales in 2002 were about \$28 billion generated by 7,245 establishments. The figures of 2002 indicate a large and almost unrealistic reduction in sales of almost 30 percent compared to 1997.

Firm size and establishments

There are only a few large national scrap processors, with annual revenue approaching \$ 1 billion (First-Research, 2005). Typically, a local establishment processing metal scrap has an annual revenue between \$4 and \$6 million (US Census, 2004). Forty percent of industry sales are generated by the top 50 companies (First-Research, 2005). Scrap processors often own a network of small and medium-sized businesses and regional establishments (e.g., networks of scrap yards and major processing facilities) (ISRI, 1996). An establishment refers to “a single physical location at which business is conducted and/or services are provided” (US Census, 2004). Therefore, the number of firms is smaller than the number of establishments, since companies may consists of one or more establishments. Establishments help to aggregate material locally, but may not have the right power processing equipment to process all materials locally. The

⁴⁶ For more information about the classification changes please visit the following website:

www.census.gov/epcd/naics02

aggregated materials may be transported, handled and processed on a large scale at a location with the high-capacity processing equipment owned by the firm. It often depends on local processing capability, the type of materials and value-to-weight ratio (Interviews). For example, larger firms often have a specific non-ferrous department, since such materials may be traded nationally or internationally, due to their relatively high value-to-weight ratio.

Table 3: Change of the recycling industry between 1992, 1997, and 2002

Classification	Description	Year	Establishments	Sales (\$1,000)	Annual payroll (\$1,000)	Paid employees
SIC 1987	5093 Recyclable materials	1992	8,928	24,461,997	2,269,134	98,005
	5093 Recyclable materials	1997	9,088	38,748,659	3,229,092	114,992
NAICS 2002	42393: Recyclable material merchant wholesalers	2002	7,145	28,207,100	N/A	N/A
NAICS 2002	425120: Wholesale trade agents and brokers, w/ product lines of recyclable materials	2002	109	583,010	N/A	N/A

Source: US Census Bureau, 2005

In 1997, the average number of employees per establishment processing iron and steel scrap varied between 7 to 16 people (Economic Census, 1997). Furthermore, the average payroll per establishment varied between \$26,000 and \$30,000 (Economic Census, 1997). However, over the last decade, the industry is consolidating due to increased need for large capital investments in higher capacity powered equipment, to enable larger economies of scale (Sieling, 1990). As a result, the number of small size firms is reducing (Sieling, 1990). For example, regional recyclable material wholesalers may buy smaller rivals, which then become part of the network of the bigger rival (Harler, 2001).

Processors handling multiple materials

The recycling industry is a compilation of a diverse range of firms specializing in specific materials. Most material markets are independent of each other. However, some firms will collect and/or process multiple materials such as ferrous and non-ferrous metals, because there are some cost advantages to operating a scrap yard handling multiple products. Processors may process only a limited number of materials and trade the other materials as semi or unprocessed.

Degree of processing

Processors represent a crucial step in the transformation of materials, by processing raw, intermediate and finished recyclable materials. Materials collected differ in the degree to which they need to be processed before they are ready for consumption. The processing of recyclable materials may therefore occur through a set of multiple stages of processing

operations, before they become ready for consumption. Therefore, there are unprocessed, semi-processed and fully-processed recyclable materials available on the marketplace. For example, old scrap need less effort, time and operations to process the materials in comparison to post-consumer scrap. Post-consumer materials may require multiple steps of material processing to separate, sort and densification. Wholesalers may be specialized on specific products or types of processing. Therefore, the further processing steps may be performed by other recyclable material wholesalers.

The activities and machinery that are necessary for processors to sort, densify, grade, etc. add a relatively large amount of value to the materials in comparison to consumers/manufactures. Still, the concentration of materials by processors does not mean a transformation of the recovered materials (Beck, 2001). However, more and more processors try to move up the value chain by preparing specific mixes of scrap, which can be readily used by consumers (Interviews). Processors have the highest productivity in comparison to collectors and consumers.

Geographical concentrations

Recyclable material wholesalers are concentrated in the Midwestern states (Table 4). The geographical concentration of recyclable material wholesalers within the Midwest, California and Texas seem to indicate that processors tend to co-locate with major geographical concentrations of major manufacturing population centers.

Table 4: Geographical markets of recyclable materials wholesalers in 1997

State	Establishment s	Sales (\$1000)	Sales (% of US)	Annual payroll (\$1000)	Paid employee s
United States	9,088	38,748,659	100.00	3,229,092	114,992
California	1,000	4,549,177	11.74	344,894	13,710
Illinois	493	3,002,687	7.75	194,916	6,104
Ohio	506	2,965,099	7.65	226,257	7,018
Pennsylvania	509	2,932,908	7.57	192,210	6,589
Texas	602	2,575,696	6.65	226,198	9,341
New York	623	2,395,829	6.18	222,734	7,975
Missouri	214	2,339,099	6.04	75,478	2,486
Michigan	357	1,671,632	4.31	145,572	4,448
New Jersey	382	1,390,668	3.59	162,817	5,331
Indiana	245	1,193,752	3.08	125,471	3,789
Georgia	259	955,894	2.47	85,100	3,044
Wisconsin	213	911,631	2.35	91,009	2,938
Alabama	170	778,065	2.01	65,271	2,388
Total of 13 states	5,573	27,662,137	71.39	2,157,927	75,161

Note: Only states with sales over 2 percent of the total sales in the US were included.

Product markets

The recyclable wholesalers process a variety of categories of materials, where ferrous metals, non-ferrous metals and paper represent the largest categories by sales (Table 5). Other recyclable material categories, such as plastics, rubber and organics are grouped within the 'other recyclable materials' category (US Census Bureau, 2005). The largest

product segment by sales are firms engaged in dealing and processing all forms of ferrous scrap (e.g., iron and steel) with sales of \$10.8 billion and 3,971 establishments in 2002. These ferrous scrap metals processors use power-generated processing and preparation equipment to move, shred, shear, bale and strip recyclable materials. The broken and sorted grades of iron and steel scrap are sold in the marketplace.

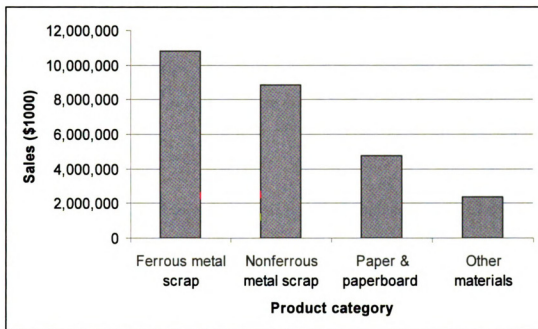
The second largest group of recyclable materials by product sales are wholesalers and processors of non-ferrous metals and alloys, with sales of \$8.9 billion and 4,308 establishments in 2002 (US Economic Census, 2002). The four major product categories are aluminum, copper/brass, zinc and nickel (USGS, 2003b). The third largest product group by sales are wholesalers (processors and dealers) of recyclable paper and paperboard scrap (corrugated boxes, office paper, newspapers, etc.), with sales of \$4.8 billion and 1,840 establishments in 2002. The fourth largest product groups of recyclable wholesalers by sales are firms who process and distribute a variety of recyclable materials, with sales of 2.4 billion and 2,004 establishments in 2002. This product segment includes materials such as plastics (e.g., bottles made of polyethylene terephthalate (PET)), glass cullet, textiles, and organic materials (ISRI, 1993a, 1993b, 1993c).

Table 5: Recyclable material wholesalers by type of business, US, 2002

Products and services code	Description	Sales (\$1,000)	Nr. of establishments	Sales (\$1,000)/ establishments
10000	Industry total	28,207,100	7,145	3,948
12900	Ferrous metal scrap	10,833,940	3,671	2,951
12920	Nonferrous metal scrap	8,863,063	4,308	2,057
12930	Recyclable paper & paperboard	4,777,328	1,840	2,596
12940	Other recyclable materials	2,387,920	2,004	1,192

Source: US Census Bureau, 2005

Figure 16: Sales of recyclable materials wholesalers by product category, 2002



Source: US Census Bureau, 2005

Value-to-weight-ratio of scrap metals, paper and plastics

Generation occurs on a local and dispersed scale. Co-location of processors with consumers reduces the relatively high transportation costs. Processing establishments often serve regional markets (e.g., consumers using recyclable materials as feedstock) to minimize these transportation costs, which is one of the reasons that firms are somewhat confined to regional markets concerning the material which can be collected, aggregated, processed and sold.

Regional processing to reduce transportation costs contributes to the relatively large number of Small and Medium-sized Enterprises (SMEs) who process recyclable materials for a regional market. The low value-to-weight ratio of, for example, scrap iron and steel, encourages regional markets where materials are processed in relatively close geographical proximity to the source (generators or collectors). The relatively high transportation and shipping costs discourage long-distance transportation of especially low-grade types of scrap (First-Research, 2005; Gruver & Giarratani, 2005) and reduce the possibilities of aggregating and processing materials on a national scale. Materials with a higher value-to-weight ratio (e.g., non-ferrous scrap metals) and higher grades of scrap metals are more marketable across greater distances and may be sold in national and international markets.

The differences between the volume (Table 6) and the sales generated from the recycled materials (Figure 16) shows that the value-to-weight ratio differs greatly among product markets. Non-ferrous metals and plastics have a relatively high value, followed by ferrous

metals and paper. Glass and organic materials have a relatively low value. For example, the amount of non-ferrous scrap metals is 9.3 million tons, ranking only fourth in volume. However, according to the sales of different product markets, non-ferrous metals are the second largest product market.

Table 6: Annual volume of processed recyclable materials each in the US

	Types of materials	Tonnage/US (million) Separate materials	Total Tonnage/US (million)
Product categories			
<i>Ferrous metals</i>			70.0
	Iron and steel	70.0	
<i>Non-ferrous metals</i>			8.3
	Aluminum	4.1	
	Copper	1.5	
	Lead	1.4	
	Stainless steel (Nickel)	1.1	
	Zinc	0.2	
<i>Paper and paperboard</i>			60.0
<i>Plastics (b)</i>			3.0
	Post-consumer plastic bottles only (d)	0.8	
<i>Scrap glass or cullet</i>	<i>Beverage containers only</i>		3.5
<i>Organic materials (b)</i>	<i>Yard waste</i>		46.3
Total			191.1

Notes: The tonnage is derived from the Institute of Scrap Recycling Industries (ISRI, 2004). If more specific information could be acquired other than ISRI than quoted as follows: (Beck, 2001) refers to (b), and (d) refers to (APC, 2003)

4.1.4. Brokerage

Trade agents and brokers facilitate the matching of buyers (e.g., steel mills) and sellers (e.g., recyclable material processors) (Fenton, 1998). Trade agents and brokers perform their services for a fee or a commission for their services, but do not take ownership to the materials they sell or buy (Census, 2004). Brokers will not own the goods they buy or sell but “act on behalf of the buyers and sellers of the materials, and do not have storage or processing facilities” (US Census, 2004; Fenton, 1998).

Brokers often work with consumers to procure scrap to reduce transaction costs (e.g., the number of interactions of consumers with supplier), aggregate supply and reduce the uncertainty of supply (Interviews). For example, brokers may reduce procurement costs for consumers, since they only have to deal with one person to fulfill a particular order in a month (Interviews IN). The broker may fulfill the order by buying at a variety of processors, which can deliver the wanted quality and characteristics. The broker thus arranges all shipments by dealing with a large number of sellers reducing, for example, negotiation costs for the buyer to organize the competition. Also, consumers reduce the risk of not having enough or having too great a supply, since a broker can be contracted to fulfill the needs of the consumer. Situations also occur that brokers buy scrap without receiving a purchase order from buyers (Interview). For example, brokers may sell a load of recyclable materials for a good price, but must still match the supply at a later point in time (Fenton, 1998). In some cases, processors also use brokers to market their scrap (Fenton). Often though larger processors may have their own brokerage department (Interviews).

Trade agents and brokers in the recycling industry (NAICS 425120) comprise 109 establishments, with sales of over \$583 million in 2002 (Census, 2004) (Table 7). Brokerage of non-ferrous metal scrap is the largest group in sales (\$210 million) and establishments (37). The second-largest brokerage segment is ferrous metal scrap. The importance of the brokerage of non-ferrous metal scrap is strengthened when taking into consideration the fact that non-ferrous metals are second-ranked in sales for recyclable material wholesalers (see par. 4.1.3). This relative importance of non-ferrous scrap can be explained by, for example, its high value-to-weight ratio, which offers more opportunities to broker non-ferrous metals to national and international buyers, in comparison to materials with a relatively lower value-to-weight-ratio.

Table 7: Wholesale trade agents and brokers of recyclable materials, 2002

Product Line	Product Line code	Nr. Of establishments	Sales (\$1,000)	Sales (\$1,000) / Nr. of establish.	Product/ Industry total
Nonferrous metal scrap	12920	37	210,390	5,686	36,09%
Ferrous metal scrap	12900	27	132,148	4,894	22,67%
Recyclable materials, incl. plastics and glass excl. metals and paper,	12940	19	131,171	6,904	22,50%
Recyclable paper and paperboard	12930	26	109,301	4,204	18,75%
Total of recyclable materials segments		109	583,010	5,349	100,00%

Source: (Census, 2004)

4.1.5. Consumption

The largest recycling industry segment in terms of sales, employment and payroll is recycling manufacturing, which consists of the consumers of recyclable materials. Consumers of recycled materials rely on collectors and processors to supply and process the needed materials. The relatively high added value generated from the manufacturing activities is the result of the fundamental transformation of recyclable materials during the manufacturing processes, to produce new products and materials with a much higher value than recyclable materials.

The manufacturing process in which recyclable materials are transformed by consumers adds the greatest value in the recycling industry (Beck, 2001). The recyclable materials are used as raw materials with a relatively low value for the manufacturing of products with a relatively high value (Beck, 2001). Consumers use recyclable materials often as a substitute for virgin (primary) materials, such as pig iron, minerals (e.g., bauxite), virgin resins and paper pulp. Producers fulfill demand of primary metals from economic sectors such as infrastructure, construction, manufacturing and automotive. Consumption involves the actual conversion of recyclable materials into new products (PA-DEP, 2005). The major consumers or recycling manufacturers are steel mills (having limits on the use of scrap metals), mini-mills (having no limits on the use of scrap metals), foundries, nonferrous metal manufacturers, plastic converters, paper and paperboard mills. Consumers employ over 64,000 people with a payroll of almost \$2.5 billion and annual sales of over \$15.5 billion (Beck, 2001).

Recyclable material wholesalers are dependent on the needs of consumers. Consumers increasingly developed an appetite for recyclable materials during the second half of the last century, due to changes in manufacturing processes of steel, paper, plastics and other materials. Over the last decade there has been a shift towards production technologies that use recyclable materials to produce new products and materials at lower costs on a smaller scale (Johansson & Holappa, 2004; OECD, 2003).

For example, rapid growth of a new technology to produce steel occurred over the last decade, through so-called mini-mills or electric arc furnaces (EAF). Mini-mills can use up to 100 percent of scrap for their charges to produce metals. The older technology, basic oxygen furnaces (BOF), could use no more than 30 percent of scrap content within their production process (Fenton, 1998; OECD, 2003). One of the major reasons for the rapid growth of mini-mills is that they can produce at lower costs and on a smaller scale in comparison to BOF. In the late 1990s, BOF accounted for about 55 percent of total steel output, but only consumed about 20 percent of scrap resources. Meanwhile, mini-mills produced 45 percent of total steel production but consumed more than 60 percent of the total scrap available (Fenton, 1998).

The cost advantages of recyclable materials over virgin materials also influence the demand of consumers. The greater the cost advantages of recyclable materials the greater the demand from consumers. For example, scrap metal has to compete with scrap substitutes (e.g., directly reduced iron). The amount of price difference between virgin, scrap and scrap substitutes influences the demand for scrap.

4.2. *Use and effects of Internet tools*

4.2.1. *Abundant use of online price information services*

Recyclable material wholesalers use online services which distribute and publish price and market information in paper and/or electronic format (Interviews A - P). These online services distribute real-time price information from the major commodity exchanges for primary non-ferrous metals, such as the London Metal Exchange (LME), NYMEX/COMEX in New York and the Shanghai Futures Exchange (SHFE). The official commodity and future exchanges continuously generate market information, such as intra-day and closing prices, which are closely monitored by the recyclable material wholesalers (Interviews A-P).

Commodity exchanges offer their own online services to access price data and trading systems to perform trades 24-hours a day (e.g., buying or selling copper futures), such as LME Real-time Market Data (www.lme.com), and NYMEX Access (www.nymex.com). There are also independent online services such as Bloomberg Professional service (www.bloomberg.com) and Reuters Trader for Commodities (www.reuters.com), providing 24-hour access to third party and contributor pricing data from major exchange worldwide in real or delayed time.

Polling price data on recyclable materials

However, many firms in the recycling industry make use of specific services providing prices of recyclable materials used by metal and steel traders and recyclable material wholesalers and consumers (Interview IB). Examples of the two leading specialized real-time data feed services are Platts Metals Alert (www.platts.com/Metals) and Marketwatch provided by American Metal Market and Metal Bulletin (www.ammmarketwatch.com) (Interviews F, L, H)⁴⁷, which can be integrated with, for example, Bloomberg. These suppliers offer similar services to resellers, such as real-time price feeds from the major metal exchanges (LME, NYMEX/COMEX, Tokyo, Shanghai, and Kuala Lumpur), quotes, news and analyses, historical data, charting capabilities, daily or weekly email updates and summaries, etc. (Interview L and N). The added value of these specialized market data suppliers is that they also collect and publish price information of scrap metals and other recyclable materials not being traded on the official commodity exchanges (Interview IB, L)⁴⁸. The specialized price service companies perform daily, weekly or monthly regional and national surveys with selected buyers of recyclable materials to determine the prices for specific recyclable materials, such as aluminum used-beverage containers (UBCs) (Interview IB). A greater polling base provides more guarantees of the accuracy, completeness or timeliness of any information provided by these online price information services.

⁴⁷ Interviewees did not mention other online services such as Metalprices.com, Metalinfo.com, and Basemetals.com.

⁴⁸ It should be noted that in the fall of 2005 the Central Japan Commodity Exchange launched futures contracts for high-quality of scrap ferrous metals scrap; a world premiere (Turner, 2005).

4.2.2. High use of email

Small, medium and large recyclable material wholesalers use email as a business tool quite often when exchanging scrap metals. As one wholesaler noted: “Today, anybody that is in the scrap business has an email address” (Interview I-1). Another wholesaler noted that the “Internet has started becoming more of a fact of business life” (Interview L). Another wholesaler was more cautious: “Do some with email, but most by phone” (Interview O).

Interviews indicate that email is often used as a tool assisting in determining product offerings, search and negotiations. Email is used to confirm orders and agreements, to change agreements, to inform buyers, to make announcements to buyers, to remind buyers and to coordinate activities (Interviews). Email is further used to electronically exchange documents, contracts, invoices, etc. Documents are sent by email during the negotiation of the price and other factors, as well as to finalize paperwork of a purchase contract. For example, a wholesaler noted that she gets an email whenever materials are loaded in a container (Interview H). Also, buyers “mail or email you an invoice” (Interview L) “depending where you are” (Interview H). Another wholesaler noted that email is often used for many purposes: “A lot of information is exchanged about prices, market confirmations, offers and tenders” (Interview F).

Email benefits

Wholesalers communicate continuously with potential buyers. Wholesalers provided many instances in which email has reduced coordination costs. For example, a wholesaler noted that “communication is so much quicker” and “email saves time” (Interview F). “The biggest benefit of the Internet [and email] is saving time” and stated that he emails customers since it is faster than “snail mail” (Interview PF). Also, wholesalers noted that “it’s a lot less phone tag with the emails” since “people are at least able to leave the message” (Interview L). The same wholesaler also noted other advantages of email: “I can put them [purchase order] in our computer system and print them out a hard copy, typically to mail or fax to somebody. Well, now I can just send an email and attach it and they’ve got it right now. I know it goes to the person we intended it to and vice versa.” (Interview L). Another wholesaler simply stated that “email replaces phone calls” and enabled the processor “to do more in less time” (Interview C).

Thus the interviews provide strong indications that email use has resulted in a reduction of coordination and safeguarding costs for sellers of recyclable materials concerning business communications and interactions, in terms of increased speed and accuracy of interactions.

4.2.3. Low use of Web-based auctions

The case studies indicate that wholesalers use real-time data feed services continuously. Email use is also widespread within inter-organizational exchange. Wholesalers indicated that real-time data feed services and email reduced coordination and safeguarding costs. Contrary to our expectations, recyclable material wholesalers in the United States only rarely use Web-based auctions to conduct online transactions.

Scrapmetalauction.com⁴⁹

Only one actively-used Web-based auction was identified within the nonferrous product market, which is the second largest industry segment of the recycling industry. Recyclable material wholesalers who want to sell scrap metals via a Web-based auction do so by using “Scrapmetalauction.com”. This auction predominantly offers nonferrous scrap metals up for auction. “Scrapmetalauction.com” is able to keep attracting buyers and sellers to their auctions. “Scrapmetalauction.com” started off as a consortium owned by various scrap metal wholesalers, which raised issues about the non-partisanship of the venture (Marley, 2000). However, the Web-based auction changed ownership in late 2001, when it was acquired by an independent information management firm and was also redesigned.

⁴⁹The name of the interviewed auction is not revealed.

“Scrapmetalauction.com” enables sellers to organize Web-based auctions where registered buyers (e.g., wholesalers, brokers and consumers) can bid on scrap loads. The use of “Scrapmetalauction.com” is free for buyers. Sellers need to pay a transaction or subscription fee to put their materials up for auction. The auction listed 28 registered sellers who had previously sold a load of scrap through a Web-based auction. The number of loads of materials up for sale averages about fifteen to twenty auction sales a month. More information about the specific materials sold on the auctions was gained by interviews of sellers, as well as the owner, which was afterwards confirmed by the website of the Web-based auction. Sellers can select a specific auction format, such as open-bid auctions, sealed-bid auctions, negotiated buys (RFQ) or negotiated sales. Sellers on “Scrapmetalauction.com” also organize on some occasions closed-bid auctions, although this is a less popular auction type in comparison to the open-bid English auction type.

Opposing views on Web-based auctions

Recyclable material wholesalers have contradicting views on the use and effects of Web-based auctions. In the first case, a small group of auction sellers continues to use the auction due to the experienced benefits discussed below (e.g., a reduction of transaction costs and satisfactory prices). Meanwhile, a large majority of interviewed wholesalers were quite skeptical of the use of Web-based auction. The subject caused quite a “disturbance” among many wholesalers, expressed in terms of harsh criticism (Interviews). Below the experienced effects for sellers are discussed in an effort to gain a

greater understanding of the factors contributing to the use of the studied Web-based auction.

4.2.4. Overview of propositions

Below a discussion follows of the interviews and quotes that illustrate the opinions of the interviewed recyclable material wholesalers concerning the propositions on the antecedents and effects of the use of real-time data feed services, email and Web-based auctions.

4.3. Transaction attributes

The three propositions concerning transaction attributes are here discussed.

Proposition 1a proposed that the use of communication-like Internet tools reduces coordination and safeguarding costs associated with price uncertainty. The majority of the firms used the three Internet tools to reduce uncertainty about prices.

4.3.1. Real-time data feed services and price uncertainty

Future exchange prices of primary metals

Scrap or secondary metals are not traded on commodity exchanges (Interview F, N, L). However, the established exchange prices of primary metals act as the main reference point for scrap metal wholesalers in regards to price negotiations with buyers (Interviews N, L, N, F). Exchange prices are “used as a guideline for the valuation of materials” (Interview Q-2). For example, each grade of scrap metal receives a specific discount or premium that is applied to the price of primary copper, aluminum or other metals (Interviews F and L). Two interviewed firms stated the following:

“It’s a factor off of LME or for the quality of scrap” (Interview Q-2).

“Scrap is a substitute for the primary material of copper cathode. So, if it [copper cathode] is traded off the December COMEX today and you [the seller] would have to pay maybe [x amount of] cents over COMEX cathode and he [the seller]

is able to buy number 1 copper for [y] cents under, he's made himself a [x + y] cent cheaper buy" (Interview C).

The price scrap processors may get for their material is "a premium from the LME, which depends upon the demand and freight rates" (Interview L), "contaminants and everything else" (Interview Q-2). Furthermore, materials may contain different percentages of different types of non-ferrous scrap, which may be difficult to assess.

Reduced prices of subscription of online services

In the last decade, subscriptions of real-time data feed services have come down from thousands to only hundreds of dollars for a monthly subscription (Interviews). The price of subscription to the real-time pricing services varies depending on the lag time for users awaiting prices of commodity exchanges. Subscription prices are generally lower when prices are forwarded with a greater delay in time. Some prices established at the commodity exchanges are now published freely on the Internet with a certain delay. Still, wholesalers need access to real-time prices to effectively perform transactions on commodity exchanges such as a related buying call or making use of options for hedging provided only by the online services (Interview H). Overall, real-time data feed services have become more affordable and therefore have become more accessible to small and medium-sized enterprises (Interviews A and H). It should be noted that wholesalers do not quibble over the price of these online services, but rather see them as a critical tool for any wholesaler conducting business.

Reduced uncertainty about regional price variations

Real-time data feed services cover most non-ferrous metals. Real-time data feed services provide regional prices, which incorporate the variations in transportation costs across the US. However, only one wholesaler discussed this issue during the interviews. For example, real-time data feed services provide one of the most widely-used aluminum prices in the United States, namely the “Midwest Transaction Price,” directly on the day the price is determined; it also includes the comments of the survey participants. Additionally, a broad range of other non-ferrous scrap metals are available, such as a benchmark of US secondary aluminum alloy prices, including two weekly commentaries on the days that prices are surveyed (Platts, 2005).

Purchase contracts are often based on exchange prices. For example, one wholesaler stated the following:

“There are certain customers [where]. . .the price is based off of LME but more so the Midwest Transaction Price from Metals Week. . . , because that correlates more of what the market price is here in the Midwest United States. Our price will be a differential from that price. The premiums differ over time since it [the premium] depends upon the demand. . .and the freight rates” (Interview L).

Hence, the findings indicate that recyclable material wholesalers use real-time data feed services, factoring in transportation costs of materials for specific regions. This usage reduces negotiation and price discovery costs for sellers, because it becomes easier to

analyze the complexity of transportation costs (e.g., regional and temporal variations in freight rates) on the spot.

Online access anytime and anywhere

For quite some time, there existed services publishing price and market information in paper format. In the last decade, these services have become increasingly available online (Interview B, H, PF) and via email (Interview PF). A processor stated that emailed price updates enabled him to be more in touch with market trends, since the paper price bulletin would take three to seven days longer to arrive (Interview PF). Another wholesaler stated:

“We get our American Metal Markets which used to be mailed as a newspaper; now they’re emailed. Before, we never knew when they were going to come in. So, it is a much better system” (Interview L).

Besides providing daily or weekly email updates, real-time data feed services also provide services for Internet-enabled mobile devices such as Blackberries and cell phones. In this way, wholesalers can easily stay up-to-date regarding exchange prices and other news when on the road (Interviews A, C, K). Wholesalers often go abroad to visit consumers (Interviews C, D, F, H, O, J, L, N). As stated a wholesaler on necessities when on the road:

“You need three pieces of electronic communication. . .you need a telephone, you need to be able to see the exchange and know how it’s trading and you need to be able to have access to your email. We are all expected to do more in less time all

the time. One of the latest examples of the Internet helping our business has been the Blackberries” (Interview C).

Small, medium and large recyclable material wholesalers of scrap metals use online price information services to be constantly updated about the activities of the world’s leading commodity exchanges (Interviews). Small price-per-pound fluctuations may strongly influence the profit margins of sellers (Interviews C, H, L, N). Also, a lack of up-to-date knowledge about prices may damage bargaining position while negotiating a deal with buyers (Interviews).

Determining product offerings

Wholesalers commit materials to specific sellers, but sometimes these sellers require less product for a specific month, thus providing wholesalers with a spot market opportunity. Real-time data feed services and information sharing among market actors provide market data, making it easier to determine willingness to sell, reducing costs related to the discovery of product offerings.

“If, say, the LME spikes up and. . .we have not committed all the material [to a long term sale], we may take advantage of that. Uncommitted material may be sold based on our ‘gut’ feel and [if] we hear that the markets are going to go up. . . we might not sell. But then again, if we feel just the opposite we may sell forward so that we’ve already got a price locked in” (Interview L).

Idiosyncrasy of the metal business

The recycling market is characterized as an opaque market, due to a lack of unbiased and accurate prices and demand and supply indicators (Interview UG). Price information (even prices derived from exchange prices of primary metals) is therefore in great demand among traders, since prices are crucial for trading and doing business. Still, prices per pound of many grades of recyclable material vary within a specific range. That range can still translate into price differences of thousands of dollars for a single transaction. “The idiosyncrasy of the metal business,” such as the existence of many different commodities, increases the complexity of each transaction and makes each transaction unique and different from the other (Interviews B, C, F, H, I, J, L, N). Many wholesalers argue that scrap is not really a standardized commodity, or as one wholesaler stated, “scrap is a commodity in name only” (Interview F). Processors need to be very flexible and a “true jack of all trades” (Interview L) to engage in negotiations, to search for suitable and interested buyers and to determine a price for materials that must be justified by the wholesaler to the buyer. This is why relationships are so important (Interview A-P). Thus, the heterogeneity of scrap metal materials still results in a specific degree of uncertainty about the specific premium or discount from the exchange prices, which is inherent to the scrap business (Interviews).

Some exceptions: Price information and the potential for rejections and downgrades

The case studies provide some indirect indications of a potential effect of real-time data feed services on safeguarding costs, although proposition 1a did not include safeguarding costs. It is uncertain whether greater access and transparency have reduced the potential

for unfair pricing. There are indirect indications that price information may increase the likelihood that buyers may want to renegotiate a specific deal, if they notice that prices are going down significantly. Rapidly decreasing prices may cause buyers to request that the seller meet for price renegotiations (Interview H, E). This may be considered part of joint-problem solving and may be resolved within a relationship (Interview). However, some wholesalers have gotten pretty upset by the fact that some buyers may act improperly by reporting problems with the material itself, to get a downgrade in light of the downward price trends on the markets (Interview E, M). For example, an industry insider mentioned the following:

"But in scraps, it [the specification] is subjective. If the markets are going up, a buyer might be a little more forgiving because he's going to have to replace that same amount of material at a higher price. Therefore he wants to be very careful. He's going to say I'm going to take it. If the markets going down, if he rejects it and then cancels the order because the guy's not delivering he's claiming, he knows he can replace it at a lower cost. So now the question is how soon can he get delivery of that other material is critical for his operations whether he rejects it or he negotiates a lower price. So, those elements do come into play that are not necessarily a change in the quality of the material, just a change through the market conditions which is not a good thing but it does go on" (Interview Q-2).

Wholesalers stated that this was again a good example of why you need to have good relationships where you can trust the sincerity and honesty of the buyer (Interview E, H, J, M). However, none of the wholesalers noted that real-time data feed services affect

safeguarding costs directly. As such, we have only indirect indications that price discovery has an effect on safeguarding. We do not have enough information to define the relationships between a greater awareness of prices because of real-time data feed services and a potential increase of safeguarding costs; further research is needed.

4.3.2. Email use and price uncertainty

Proposition 1a proposed that the use of communication and brokerage-like Internet tools reduces coordination and safeguarding costs associated with price uncertainty. Many wholesalers indicated that they used email to receive price updates, as indicated below.

Email is often used by recyclable material wholesalers to receive hourly, daily or weekly electronic price updates from real-time data feed services and bulletins. Price fluctuations can be monitored more closely through email notifications and updates, in comparison to distributed paper-based price bulletins, which were often delayed and less frequent (Interviews PF, L). Wholesalers indicated that the paper-based price bulletins were previously distributed by physical mail, which would cause prices to be delayed by one to three days in relation to the current market price (Interviews PF, L). The prices were delayed because of the time needed for printing, mailing and delivery of the paper-based price bulletins (Interview). Instead, email distribution is instant and does not have such a long delay (Interview). The recyclable material wholesaler stated that the availability of daily prices delivered by email improved his bargaining position when negotiating prices with buyers (Interview PF). Another wholesaler stated “it’s a small world with the emails

and the phones and everything else today. Not very many people get picked off as far as pricing goes” (Interview L).

Wireless email

Wireless email services enables wholesalers to gain access to more up-to-date prices while they are on the road or are away from their computer. Many wholesalers have a Blackberry or other Internet-enabled handheld devices (Interview C, F, A and observations) which are used as a phone, email device, agenda and contact list. Business people processing and trading recyclable materials use Blackberries in great number as an email tool which aids new and ongoing transactions and trading activities (Interviews). As a wholesaler stated “I use a Blackberry all the time” (Interview C). Many processors and wholesalers of recyclable materials are continuously on the road to, for example, visit clients to build, maintain and strengthen business relationships, or to inspect specific materials and plants, acquiring important information for ongoing transactions, etc. (Interviews C, I, F). Through the use of their Blackberries wholesalers access email while on the road, in the form of, for example, price updates of recyclable materials they plan to sell. Wireless email helps wholesalers do more in less time, such as communicate with buyers and perform transactions (Interviews C1 and C2). The saved time may be used to expand sales and maintain customer relationships (Interview C).

Many interviewed wholesalers indicated that they used email to get price updates. However, they did not often directly state that they experienced a reduction in price discovery costs and negotiation costs. One of the reasons is that it is simply implicitly understood.

4.3.3. Auction use and price uncertainty

Proposition 1a proposed that brokerage-like Internet tools reduce transaction costs associated with price uncertainty. All three of the interviewed wholesalers who used the Web-based auction experienced a reduction of coordination costs associated with the price uncertainty. Details of supporting quotes and interview findings are provided below.

Selling through negotiations

For comparison purposes, a short description is provided of the conventional way of selling through negotiations. Normally, recyclable material wholesalers engage in between 5 to 10 concurrent bilateral negotiations (Interviews B, C, F, I, J, N). A wholesaler stated the characteristics of how this negotiation process was performed: “Talking to people and getting people to quote you” (Interview N). Further, the wholesalers stated: “Get information from people while on the phone, and try to find out if the buyers. . . are interested” (Interview N).

Open-bid auctions

Web-based auctions provide participants a bidding mechanism to discover a price. Most auctions organized at “Scrapmetalauction.com” are open-bid auctions (Interview Q and D). The auctioneer noted the following: ‘The majority tends to be public auctions, but you have the ability to do the private auction’ (Interview Q). Materials advertised on an open-bid auction are awarded to the highest bidder. Unlike ebay.com, which has a specific auction ending time, the auctions at “Scrapmetalauction.com” only ends the sale if in the

last five minutes no new bids are placed. This auction rule of extending the auction based on activity makes it more assured for sellers that they will get the highest price; meanwhile, auction bidders know that their bids are being processed (Interview Q). Also, it reduces the incentive for buyers to try to peak their bids at the last minute, as they do on eBay. A current auction seller stated the following:

“The way I like is an open bid, where everybody sees the price. We don’t have names, don’t know who is bidding what, but we see a price. I have the capability of how much I wanna’ sell, and at what price I wanna’ sell it at. I also have a starting bid. So, a starting bid is from where everybody goes. Than I have what they call a reserve price, that is the price I am willing to sell it for. So, once they hit the reserve price, they know that I have to sell it, that is the agreement... If my reserve price is not met, I have to option not to sell it . . . I have taken that option before. When it didn’t meet it, I didn’t sell” (Interview D).

The wholesaler also noted that the Web-based auction allowed him to maximize his revenue, even when the auction did not meet his reserve price.

“Now I have done it where I have done the auction the very next day. I did the same thing again, or did it a week later, and it worked out where one time and every time I done that. . . . I always have gotten a better price (Interview D).

Reduced coordination costs to determine “who is hot”

Conventional simultaneous bilateral negotiations have the advantage of knowing with whom you are dealing. However, it is difficult to really know how much the potential buyer wants or needs the product, often referred to as determining “who is hot” (Interview Q). The auction enables sellers to engage in a new way of determining who is hot, since the auction is a more competitive price discovery mechanism, tending to reveal the individual wants/needs more than, for example, negotiations.

Auctions are assumed to reduce interaction and communication costs with regards to discover prices because of the automated processing and publication of placed bids on the auction website. Wholesalers who sell their materials on the Web-based auction experienced various reductions in coordination costs to make sure they got a fair market price for their materials, such as the cost to search for buyers, the solicitation costs of phone interactions, the costs to evaluate quotes and the costs to engage in sometimes time-consuming negotiations (e.g., making arrangements for shipping). Wholesalers had this to say about the reduced search costs when using the Web-based auctions:

“I sit back and relax, watch the auction on the computer screen and the sale is done”

(Interview D).

“Another advantage of the auction is the ability to reach far more people. The auction helps to cast the net farther out, potentially to international buyers. But this holds not through for a lion share of the recycling business. Rather, the internet should be regarded as a complimentary tool. . . marketing for free” (Interview N).

“The internet [the auction] can be used as somewhat as an. . . efficient consolidator, in terms of allowing these people to have access to bid on your material, without taking up huge amount of time, . . . qualifying who the potential buyers are going to be” (Interview I).

“Now, they [the seller] always have their own regular buyers that they encourage to utilize and to bid on the scrap, but they get new people which is the value of the Internet, to reach out the marketplace to new people, because you never know who may be interested in the material” (Interview Q).

There are several reasons why buyers are more willing to pay. For example, a buyer may be “short” (meaning not having enough materials to fulfill his contract obligations) because a previously-negotiated deal fell through (e.g., below-standard quality of materials) (Interview N and E). The buyer still needs to fulfill his own contract obligations because he/she does not want to violate the trust of his customers (Interview E).

A buyer who is short can use the auction to buy the needed materials. During bilateral negotiations, a buyer might have gotten away with certain behavior, because he was able to hide his needs (Interview Q). However, when bidding on an auction, the buyer has more incentives to beat the other buyers. A wholesaler who sold at the auction came across such a situation only after he noticed that an auction outperformed his

expectations. At a later point of time, he heard through his informal "connections" that the buyer at the auction was in great need of the materials (Interview D).

The greater competition among buyers also seems to increase the willingness of buyers to place higher bids, or, as one wholesaler stated it: "Be more aggressive" (Interview D).

The interviewed sellers noted that they get satisfactory prices for their materials, which sometimes meet or surpass their initial price expectations (Interviews D and N).

Role of future exchanges

Although auctions may improve the way firms discover prices, their use might be still limited because the future markets also facilitate a reduction of price uncertainty. As a wholesaler stated:

"Nonferrous scrap. . . copper, aluminum, and brass have some relationship to the trading metals on the LME or the COMEX in New York. Their relationship may change relative to their own client demand characteristics [thus from the exchanges], but they have some basis for their value. It's always going to have some relationship to that, so it doesn't have to be on an auction site for people to be able to get together and determine an approximate value of that. The marketplace does a pretty good job of that in and of itself" (Interview C).

The argument provided above does not mean that auctions cannot reduce price uncertainty to a certain degree.

Overview of three Internet tools

From the previous discussion of the majority of the findings, we can strongly support **Proposition 1a**, since the use of communication and brokerage-like Internet tools reduces coordination costs associated with price uncertainty. However, some interviewed firms raised some critical issues.

4.3.4. Real-time data feed services and email: Product specificity

The case studies did not provide evidence that product specificity influenced the use of real-time data feed services. Further, the interviews did not indicate that product specificity affected the use of email.

4.3.5. Auction use and product specificity

Proposition 1b proposed that the use of Web-based auctions increases coordination and safeguarding costs associated with product specificity. Below details of quotes and interviews summaries are provided to test this proposition.

Degree of hand processing

The interviewed wholesalers indicated that the auction only served “a very narrowly-defined market” (Interview N). The Web-based auction is used for highly specific materials, requiring a high degree of manual labor to sort and process this particular type of scrap. Wholesalers stated the following:

“The items which are put on the Website [‘Scrapmetalauction.com’] are highly specific. For example, they have an appeal to overseas buyers. Making it at best a form of advertisement” (Interview N).

“Oh, you are talking about low grade materials, that need very. . . high degree of hand processing, and of course, they go overseas to places like China [for] the labor. They have a whole different labor market than we do, and therefore they are actually able to do it economically, whereas over here you just couldn't do it economically. So, the home is for that type of material [is China, such as]. . .an electric motor that got some plastics, some speedles and copper, and wire windings in there, sometimes aluminum inserted, and you know ...there is no way you really going to process it efficiently here in the United States. So it is automatically an export item and with the many, many, many people out there who are trying to buy scrap for export out of the United States” (Interview I).

Examples of low-grade nonferrous metals concentrates which are often traded on the Web-based auction are electric motors, ZORBA, Red Shredder Pickings, wires and cables. For example, in June, nine firms were able to sell their materials on twenty-one public auctions⁵⁰. The total quantity sold of the twenty-one individual sales was 6,573,000 lbs., of which ZORBA was the largest category at 1,822,000 lbs. The second-

⁵⁰ The figures are derived from a published series of examples of recently completed public auctions at ‘Scrapmetalauction.com’.

largest category was electronic motors (including AC and DC) at 1,530,000 lbs., followed by “Shredder Pickings” with sales totaling 826,000 lbs. The three main categories accounted for 64% of all materials in weight. Successful auctions were also held for other types of materials, but with smaller quantities.

Material with the ISRI ⁵¹code name ZORBA refers to recyclable concentrates of shredded, mixed, nonferrous scrap metal in pieces. This material is derived from machines (e.g., fragmentizers) which shred, clean and separate all types of material. ZORBA can contain various nonferrous metals, such as aluminum, copper, lead, magnesium, stainless steel, nickel, tin and zinc. The percentage of nonferrous metals varies from shredder to shredder and is agreed upon between a buyer and a seller. For example, ZORBA 73 indicates an estimated nonferrous metal content of 73%. ZORBA may also contain iron, iron attachments, other metals, moisture and high-density materials such as rock, glass, rubber, plastic and wood. Red Shredder Pickings refers, for example, to loose materials with a copper content of, say, 19-22%, which is derived from copper-bearing materials such as auto shredders, armatures, starters and harness wire.

The interviewed wholesalers based in the United States often put types of nonferrous scrap metals up for auction that are mixed in with multiple other types of materials, such as plastics and metals. These types of scrap are a product of earlier processing by US-based firms (e.g., recovered from car bodies or appliances) and often include various

⁵¹ Institute of Scrap Recycling Industries, Inc.

metals, alloys, plastics or other impurities and contaminations. However, such semi-processed materials are difficult and costly to process further by machines in the US. Most of the time, these materials need to be processed manually, to be sorted, processed and dismantled. Firms interested in these types of scrap are often importers and wholesalers located in countries with an abundant labor supply and very low labor costs (e.g., China) (Interviews). For example, in China people are stripping copper cables from plastic by hand for two dollars a day (Interview H). The cost advantages of wholesalers located in low-cost Asian countries such as China and other Asian countries explains why they have such a great appetite for these types of materials. This makes them "aggressive" bidders on online auctions, where they compete with multiple buyers from such countries, in an already tight scrap supply market.

Hence, the findings provide no support for **Proposition 1b** that states that use of brokerage-like Internet tools increases coordination and safeguarding costs associated with product specificity. On the contrary, the auction provides access to low cost manual labor, which reduces the specificity of the materials

Sellers' incentives to "standardize" auction sales

The auction sets all the contract details of the sale, such as payment, shipping, packaging, quantity and content. The reason is that the auction tries to fix or "standardize" the terms and conditions of a sale, to reduce complexity and increase price comparability. For example, auctions sales are all sold "as is," so that the material will be picked up at the seller's location, who will be paid cash in advance. As a wholesaler stated: "We are

selling material like that [on the auction]. One of our main qualifications is, you know, they must pay cash in advance” (Interview I). One of the reasons is to reduce the risk of dealing with buyers the seller does not know, and to reduce interaction costs. For example, if the auction seller ships the material overseas, he/she still has to wait and see if they will be paid by the buyer (Interview H).

Sellers’ inability to explain the value of materials

Wholesalers criticized the use of Web-based auctions because they focus too much on price and not on quality, content, and other aspects of a transaction (Interviews). During conventional negotiations many issues are discussed and agreed upon, such as those relating to customization, loading, shipping, delivery by the seller and the providing of credit to the buyer, which are removed from the auction environment (Interview N and K). The aspects of a negotiation which are fixed for an auction sale are typically the ways for wholesalers (the seller) to differentiate themselves from the competition and add value to a transaction (Interviews B, E, F, I, J, K, M, N).

Moreover, recyclable wholesalers refer to recyclable materials as commodities, but overwhelmingly argue that scrap materials are very heterogeneous in nature (Interviews). For example, materials are often buyer-specific (Interview N). Sellers also mentioned that they often have to “explain” the value to a potential buyer before a deal can be closed (Interview I, K, N). Wholesalers argue that human interaction, such as by phone and face-to-face meetings, helps sellers to explain the value to potential buyers, assess deal complexity, make a risk assessment and customize material (Interview C, F, I, N).

Personal interactions, in combination with relationships, create an environment characterized by trust, integrity and honesty, enabling sellers to “explain” the value of the materials, which is often not obvious and already known by the buyer (Interview K, N, I, J). A wholesaler noted that auctions are unsuitable to sell materials which are fairly complex in substance and for which complexity cannot be reduced for the purpose of being sold at auction (Interview K and N).

“[There are] so many variables of shades of grey. .The Internet is not going to solve it. . . .You have to convince people what it is worth of value, you have [scrap materials that are] highly definitional [and you need to be able to] express the commodities value” (Interview N).

Another wholesaler wondered during a conference:

“Whether scrap could trade on a business-to-business site like steel, how issues like product quality and inconsistent buyer specifications would be resolved and whether the Internet would free scrap from the restraints of freight costs and allow access to broader markets” (Marley, 2000).

The statements of the auction sellers and dealers provide indications to support **Proposition 1b**, since auctions seem to increase coordination and safeguarding costs concerning the product specificity of the majority of scrap metals. However, as pointed out earlier, the experience of the three wholesalers using the auction also provide reasons to partly discard **Proposition 1b**, concerning a very narrow product group of nonferrous metals, since for these materials coordination costs are reduced.

4.3.6. Real-time data feed services and frequency

The study found no indications that recyclable material wholesalers use real-time data feed services to reduce problems with materials they sell infrequently.

4.3.7. Email and frequency

There are indirect indications that infrequency of transactions contributed to the use of email in dealing with buyers in export markets. Email is used by multiple wholesalers to communicate with buyers overseas. A wholesaler stated that email in negotiations “is an important part [of business], but the phone still plays a big part, especially domestically where each of these guys talks to each other” (Interview I-1). Email is sometimes preferred over phone conversations by buyers due to the language barrier which may be present when engaging in international trade. For example, sellers noted that email helped reduce the complexity of dealing with buyers overseas (mainly Chinese), because buyers in China were using translation software and services to improve their understanding of the details of a transaction communicated by email (Interview F). Buyers use translators or translation software to read and write emails, purchase contracts, etc.

The wholesaler noted that translation services for email messages reduced the chance of misunderstandings between the buyer and seller (Interview F), such as the specific contents and other specifications of the transaction. It may happen that a buyer misunderstands the statement of the seller on the phone that the content of copper of a specific load is not 97% but 96% (Interview F). It should be noted that a difference of

only 1 percent can make a big difference in the price of the materials. Email may therefore reduce potential misunderstandings during negotiations between buyers and sellers (coordination costs), as well as reduce the likelihood of buyer complaints after receiving the materials and the costs of the seller to resolve the issue (safeguarding costs).

4.3.8. Auction use and frequency

Proposition 1c proposed that the use of communication and brokerage-like Internet tools will reduce transaction costs associated with the frequency of transactions. Details of quotes and interview and their summaries are provided below, to test this proposition.

The use of Web-based auctions should be put into perspective. For example, one of the users that advocates their use sells only a small percentage of their total processed materials on the Web-based auction (Interview D). Materials, which are allocated to the auction, form only a very small portion of total incoming feedstock, not more than 1 to 2 percent of the processed materials by weight (Interview D). Existing sellers on the Web-based auction only process a relatively small amount of materials, which they are willing or able to sell on the auction.

All three wholesalers selling materials through the auction mentioned that sales were only “very little” in comparison to their total volume of trading (Interview N). This was underscored by another dealer, who said the following: “I would say a very, very small portion what we sell goes through that Internet process” (Interview I).

Wholesalers stated the following about the auction sales:

“Right now it is still a very small percentage I am selling online, because I am selling only nonferrous. And the majority of our business is ferrous. And they [the auction] don’t do any ferrous online. So, it is right now a small percentage but I can see an increase over time” (Interview D).

“But you know, we don't sell all our export stuff through an Internet website at all, we do a lot of it the old-fashioned way. You know, person-to-person. That is the way we really prefer it. . .for obvious reasons. You and I are talking here, versus you sending me an email and you respond. You know, let's face it, anytime that humans communicate you know you have a better opportunity for better communication, and therefore a better deal for both parties” (Interview I).

Materials sold on the auction are often not covered by ongoing long-term contracts due to limited incoming volume. Therefore, it takes wholesalers more time to aggregate the materials ready to be shipped by container. The materials put up for auction are also those materials which before were sold relatively infrequently on the spot market (Interview D).

Another auction seller indicated that dealing with auction sellers requires a specific way of dealing with buyers with whom they either do not have an established relationship, or who are unknown to the seller. This finding, derived from the interview with an auction seller, indicates that sellers may need to modify the way they handle sales and buyers, to prevent an increase in safeguarding costs.

“When we are selling [at auction] we are selling material like that. One of our main qualification is you know, that they must pay cash in advance. They must [be able to] keep making a commitment. There is a contract to buy the material, that means they must respond with containers sending to get that material moving within a reasonable time frame. If they are unable to do that, than you know, they are disqualified for the next time” (Interview I).

Three wholesalers indicated that they used the Web-based auction for relatively infrequent transactions. However, we can only speculate about whether or not this observation would also indirectly indicate a reduction of coordination costs. Furthermore, doing business with unknown buyers at auction requires a change in the way the business is done, to prevent an increase of safeguarding costs. Hence, there are only indirect indications that the use of auctions increases safeguarding costs concerning the use of Web-based auctions. Both observations therefore do not provide support for **Proposition 1c** concerning the use of auctions and a reduction of coordination and safeguarding costs related to frequency.

4.4. *Internet capabilities*

4.4.1. Real-time data feed services and connectivity

Proposition 2a proposed that connectivity capabilities enabled by communication and brokerage-like tools reduce coordination and safeguarding costs. Wholesalers indicated that online price services enable them to access market information of the major commodity exchanges for primary non-ferrous metals around the globe, such as the LME and NYMEX/COMEX (Interviews). These online price information services are available 24 hours a day, seven days a week, which enable wholesalers to be constantly updated about the current market situation (Interview H). In addition, these services enable recyclable material wholesalers to perform transaction exchanges quickly and efficiently (Interview H, L). Online price services also provide access to market information on scrap metals that are not traded on commodity exchanges (Interview J). Thus the findings indicate that increased connectivity enables a reduction of coordination costs for example associated with price uncertainty, whereas a reduction of safeguarding costs is not observed.

4.4.2. Email connectivity

Proposition 2a proposed that connectivity capabilities enabled by communication and brokerage-like tools reduce coordination and safeguarding costs. Several wholesalers validated the use of email by buyers to distribute calls for proposals, as illustrated below. Buyers and sellers call each other to negotiate specific deals. As many wholesalers stated: “People [wholesalers] call all the time” (Interview E) to “get an idea of the price” (Interview M). Email allows consumers to perform this digitally enabling them to reap some benefits. Email is used for concurrent bilateral negotiations by sending the same message by email to multiple firms. For example, wholesalers receive call for proposals (“purchase orders”) from consumers (“buyers”) via so-called email broadcasts, requesting wholesalers’ materials for a specific price (Interview R, L, F). Wholesalers can choose to follow-up on these purchase orders through negotiating a specific deal. Email broadcasts have become part of the daily routine concerning concurrent negotiations initiated by buyers:

“Consumers will email us daily what their prices are. . . . He sends me daily [price sheets] via email what his buying prices are. Here’s his email and it’s broadcast. He has a group of people that he sends it to. It doesn’t come just to me but I can’t see who the other people are. Here’s another one. They do the same thing and they have a broadcast list. Hers is hidden too, so you can’t see the other people but you can see the various prices” (Interview L).

Previously, the consumer would send out paper copies by mail, but now email is used: “Instead of printing this out and mailing it to us, they just attach it and email it to us. It’s

become their standard procedure. So, it allows them [consumers] to do more with their time” (Interview L).

Connecting with buyers overseas

Several wholesalers used email specifically to communicate and do business with buyers located overseas. Email is often used for transactions conducted with buyers in the US but also overseas. For example, a wholesaler noted that “doing export marketing [will involve] a lot of communication detail and offerings [which are] sent back and forth [by email]” (Interview I-1). Moreover, a wholesaler noted that “email is especially used for export markets [because you do not] have to send things by mail [and send] trial loads. Further, “email saves time [when] trading within different time zones” (Interview F), which was also noted by another wholesaler (Interview M). A wholesaler noted that “Most of the foreign correspondence is now done by email, [it] used to be by fax. It helps a lot; sometimes I get up at midnight and check my email. Communication is so much quicker” (Interview F). One of the reasons is the surge in demand from China, as several wholesalers noted.

“China’s influence has been huge for copper, what with the refineries that closed here or less consumers here anyway. It’s not because we wouldn’t sell to somebody here if it wasn’t competitive. It’s just more the demand. Certain items have gone offshore” (Interview L). “The export opportunity has created a demand that has replaced some of the demand that you know has gone away from the domestic arena” (Interview F-1). “Plus, the weak dollar has made a big difference“ (Interview L).

However, another wholesaler noted that “only certain grades of materials are economically feasible to export” (Interview N). Often-exported are non-ferrous metals. As a wholesaler stated: “Non-ferrous has to be very aggressive for it to go export” (Interview I-1).

Email connectivity and safeguarding costs

Hence, the findings provide moderate support for **Proposition 2a**, which states that the connectivity capabilities of email positively influence its use.

4.4.3. Auction use and connectivity

Proposition 2a proposed that the connectivity capabilities enabled by communication and brokerage-like tools reduce coordination and safeguarding costs. Below details of supporting quotes and interview findings are provided.

Access to buyers and one-to-one communication

The reduction of coordination costs through the use of Web-based auctions allows sellers to gain access to a larger group of buyers, in comparison to concurrent bilateral negotiations. Sellers noted that the auction enables them to access a much larger group of purchasers, in comparison to the number of buyers they can effectively contact and negotiate with by phone, fax and email. “Auctions help to cast the net farther out, potentially to international buyers” (Interview N). Furthermore, the auctioneer also provided services for the seller to reach more buyers: “We send emails to them notifying that somebody with an item they may be interested in is going to be selling on the site on x date. And those are public auctions” (Interview Q). The auction firm helps sellers in the marketing and advertising of a specific auction sale, such as through notification of potential buyers by email (Interviews D). Also, buyers can contact sellers directly (by phone and email) to inquire about the materials personally with the seller. The effects of this connectivity is discussed in the next paragraph on the complexity of product description.

National and international appeal and demand for nonferrous scrap metals

Two out of the three interviewed auction sellers, as well as the auctioneer, indicated the importance of foreign buyers (Interviews I, N, Q). A relatively high value-to-weight ratio of nonferrous scrap metals reduces the relative costs of the transportation and shipping ratio. This makes it economically feasible to reach buyers, in Asia particularly. Nonferrous metals have a reasonably high value in comparison to their weight and volume. Moreover, the shipping costs of nonferrous metals are also low, since they can be shipped by sea containers in so-called “Gaylord boxes.” Gaylord boxes are made of cardboard and are often used by collectors and wholesalers since they are economical for shipping and storage (Interviews H and L). The advantage of shipping metals and/or materials containing a certain degree of nonferrous metals by container is that they can be shipped relatively fast internationally and overseas (CIWMB, 1996).

For example, it takes about 8-10 weeks to send a container of scrap from the Chicago area to one of the main ports in China (Interview F and H). Due to the favorable ratio between the value of the materials and the shipping costs for nonferrous metals, it makes business sense to ship them across greater distances, when compared to ferrous metals. The transportation and shipping costs of nonferrous materials are less of a burden on the profit margins of wholesalers when compared to ferrous metals. As a result, nonferrous materials have a greater market reach, increasing the number of potentially interested buyers overseas, such as China and other Asian countries.

Materials with a relatively high value-to-weight ratio can be more economically transported across distance, thereby increasing the number of potentially interested buyers. However, conventional negotiating has so far limited the number of possible buyers sellers can contact for the solicitation of prices, as well as the number of buyers with whom they can engage in negotiations to work out a deal. Auctions are able to automatically process bids. Therefore, auctions enable sellers to reduce solicitation, search, price discovery and negotiation costs associated with overseas trading. As such, the auction is able to tap into overseas demand. Interviews indicated that nonferrous metals with a relatively high value-to-weight ratio are often sold on Web-based auctions for export (Interview D, I, N, Q). As a wholesaler noted: “Yeah, typically these are gonna’ be [nonferrous] materials that are going for export” (Interview I). The auction enables sellers to gain access to a larger group of buyers, in comparison to conventional negotiations (Interviews), which provide benefits as discussed earlier in relation to **Proposition 1a** (paragraph 2.6.2).

Hence, the findings concerning auction users offer strong support for **Proposition 2a.**, since the use of Web-based auction enables sellers to gain access to a larger group of potential buyers, without increasing coordination costs.

Insertion of another layer: Web-based auctions viewed comparable to brokers

Wholesalers who did not use the Web-based auction were critical of the benefits, saying that the auction provides a similar function to selling materials through a broker (Interview I, J, M) According to a seller: “The auction is just increasing the numbers of

layers” (Interview M). Another wholesaler argued that direct interaction between buyers and seller reduced the need to work with importers and exporters (Interview H). According to the same wholesaler, brokers would reduce profit margins, since they would get a piece of the pie. Thus the insertion of the auction is viewed as another way for entrepreneurs to insert themselves into the value chain (Interviews).

In contrast to auction sellers, wholesalers not using the auction did not provide support for **Proposition 2a**, since they perceived the connectivity provided by the auction as reducing operating margins.

4.4.4. Real-time data feed services and digital representation

The Internet capability to digital represent products is not provided by these predominantly text-based online services. Therefore, digital representation of products is not relevant as an incentive for wholesalers to use these real-time data feed services.

4.4.5. Email use and digital representation

Proposition 2b proposed that email enables the digital representation of products which reduces coordination and safeguarding costs associated with the complexity of product description. All wholesalers who mentioned using email verified using email for the exchange of digital pictures, as shown below.

One of the most common uses of email by wholesalers is the sharing of digital pictures of materials. The exchange of digital images has become possible since “now email with pictures can be sent with increased speed and processing power” (Interview C-1). First, email exchanges of digital pictures are used extensively for coordination activities between buyers and sellers, such as in negotiations. Such use seems to reduce coordination costs associated with communicating the quality and content of materials up for sale to buyers. Second, digital pictures are shared through email to reduce safeguarding costs associated with shipping and loading, complaints and adaptations.

“I would suggest that the Internet has been very helpful to the industry but not necessarily in the way that you might think: the auctions are fine and. . . the Internet can help. But, the Internet has been a bigger help to doing business with people because you can send pictures and short factual communications back and fourth, so that when you do get to the phone, you can actually talk to each other fairly quickly”
(Interview C).

Pictures and test loads to assess the content and quality of materials

Recyclable material wholesalers often take digital pictures of material up for sale and send it to potential buyers (Interviews). For example, wholesalers stated the following:

“Individuals in China. . . want to pay more today when a few years ago, when they had to send somebody to look at the product, or you had to box up the five gallon pail and ship it UPS overseas and they would look at it and call you back and say, “Is this representative? We used to do it that way, but today you take a dozen pictures or a hundred pictures and send it to them and it can pretty much give the details of what’s going on” (Interview I-1).

“[We] send [email] attachments with pictures so it would save a lot of descriptions and a lot of sample sending and all that sort of thing. Before, you had a long lag between samples being sent all over the country, and samples still get sent, but a lot of times pictures can suffice (Interview C).

Furthermore, pictures of materials are complemented with metallurgic analyses made by specialized and mobile devices: “Portable devices [enable] you to go look at any type of scrap and pretty much [make] the analyses of what you have. . .you can get a pretty reasonable analysis” (Interview F). Such analyses make it easier for the seller to assess the content of the materials, since “metallurgic analyses are sent [by email] with photographs” (Interview F).

Traders now often send a picture of a load of material instead of sending a test load. Sending a test load to China would take more than 8 weeks (Interview H). Often digital pictures are considered a reasonable response by sellers to requests for sending a test load, so buyers can check the quality and content by themselves. Email use thus saves time and money (Interviews). Also, email enables wholesalers to more quickly close a deal, since descriptions of materials can be done via phone and email, reducing the uncertainty of the buyer about the specific content and quality of the materials. For example, a wholesaler designed a content management system to review pictures exchanged by email to get a better feeling for the characteristics of supply, as well as to be able to improve a match between buyers and sellers for his brokerage activities (Interview M).

Benefits of the exchange of pictures

A member of the industry association stated that “attachments to emails are used significantly. So, the digital world is certainly helping in the transaction, there’s no question about that” (Interview R). Another wholesaler mentioned that email attachment of pictures resulted in “less phone calls” (Interview L). The examples above indicate that digital pictures sent by email make it easier and less complicated for potential buyers to assess the quality and content of the materials, as they were discussed during the negotiations. Email communications help the buyer to better identify and improve the understanding of the specific aspects of the transaction, such as price, content, quality and delivery method.

Conventional safeguarding of content and quality of materials

Emailing digital pictures also helps wholesalers to safeguard their transactions. Although wholesalers try to maintain the consistency of the scrap materials they process, it is anticipated that scrap materials may vary in quality or content and therefore may lead to buyers' complaint. For example, one wholesaler stated "scrap always has a problem" (Interview F), while another said: "there are always going to be issues here and there" (Interview I). Traditionally relationships help resolve these issues. Multiple wholesalers noted the relevance of relationships (Interview F, H, L). As a wholesaler explained:

"Of course you get to issues that need to get resolution to them. It is a lot easier to resolve something with somebody that you got a relationship with, versus somebody you never talked to before. And those are best resolved between entities which have a relationship" (Interview I).

Downgrades and rejections

An example of how a downgrade works was provided during an Interview when a buyer called the wholesaler, having noticed that a specific load contained excess oil. The seller reasoned that the material was lying beneath the other materials and did not get enough time to wash out (Interview L). The buyer called up the seller to discuss the problem and ask for a solution. The seller in this case agreed with a downgrade of the material (Interview L). A downgrade means that the price of the materials of a specific load or part of a load will be reduced. This example involved an existing relationship and the seller trusted the integrity of the buyer and thus agreed quickly with a downgrade, the issue being resolved in a mere five minutes. Sellers may not happy about it, but acknowledge

that it can happen and is considered part of the risk of doing business. As the wholesaler mentioned afterwards: "Sometimes you win some, sometimes you lose some" (Interview H and L).

Email and pictures, product complexity

It may also happen that disputes are not so easily resolved. Email and the exchange of digital pictures seem to help a lot here in reducing safeguarding costs for buyers and sellers. For example, sold materials may contain unexpected contaminations, which may have entered the material unnoticed while the generator performed the initial sorting. The example of the wholesaler was as follows:

"And the same the stories are still out there today of companies who will get a load to a consuming mill and it'll have pieces of steel in with the bail of aluminum. [The consumer calls and the wholesaler would reply:] 'No, it can't be, we never have anything like that. That's not our material. We would never ship anything like that. Well, until you take a picture,' and this is a true story, this part, because I was involved, 'take a picture and send the company a picture or physically bring them and look at the material.' 'Well, this is a piece of blue material and it's off their bailer.' 'Oh, we wondered where that went,' but yet the telephonic conversations, 'we would never ship any substandard quality or anything like that,' and that's part of where the relationships come in too" (Interview L).

Thus, email and the exchange of digital images provide additional tools to resolve issues between buyers and sellers after the transaction occurred. Hence, digital pictures provide strong support for **Proposition 2b** since the exchange of digital pictures by email reduces transaction costs associated with complexity of product description.

Loading and shipping

Digital pictures are taken to be able to quickly resolve potential problems which may arise (Interview L). For example, wholesalers take digital pictures of the way materials are loaded into a container when the container is ready to be sent to buyers overseas. In addition, wholesalers take pictures of the identification number and seal of the container. A picture of the way the material is loaded within a container makes it possible to verify any later complaints after the buyer received and opened the container at its destination. Pictures help to identify the nature of the problem. For example, the load may have shifted during a storm while being transported across the Pacific Ocean. In addition, pictures help identify theft of materials. Without digital pictures it would be hard for the seller to prove that it loaded the all the material in the specified way, as stated in the purchase contract. With the help of digital pictures, issues being raised by the buyer can be more easily resolved, reducing safeguarding costs for the seller.

4.4.6. Auction use and digital representation

Proposition 2b proposed that communication-like Internet tools enable the digital representation of products, which reduces coordination and safeguarding costs associated with the complexity of product description. Two auction sellers noted that auction features enabled them to close a sale after contact with potential buyers. Furthermore, there seems to be an interdependency between the complexity of product description and the connectivity capabilities provided by Internet tools, as indicated by the following quotes and interview explications.

The Web-based auction has several features to inform potential buyers about the type, quality and content of the recyclable materials up for sale. Sellers, for example, can provide a detailed description online, in addition to multiple digital pictures of the materials up for sale. The auction also enables potential buyers to directly contact the sellers (Interview Q). Both have been beneficial for the sellers.

“Yeah, oftentimes you [have contact before the auction sale with potential buyers], you just attach the pictures to the bid, when you are doing an Internet auction. . . . It oftentimes is that pictures are out there for them to access. Sometimes they tell you they want to come to the yard and look at the material in person--we encourage that. And so that kind of interaction can take place before the bidding process” (Interview I).

What’s more, sellers indicated that the connectivity provided by direct email between buyers and sellers after putting materials up for auction reduces the difficulty of

communicating the complexity of product description. The seller noted that these personal contacts require a lot less time and result in a much smaller number of phone contacts, in comparison to negotiating a deal the conventional way (Interview D).

“They are welcome to come down and look at the material, see for themselves what it is. He said, ‘I am going to bid on the material, but I would like to come down and see the material.’ I said, ‘Fine, come on down. Would you like to see more pictures than what I have?’ He said, ‘Sure.’ You know, for him to be comfortable. Here is this material of here, and here is what we’ve got here, and I just email pictures. He said, ‘That’s all I wanna’ see. I’m not coming to get it.’ And he was buying the material on the next auction” (Interview D).

Overview

The digital representation of products, namely the exchange of digital pictures by email, reduced the coordination and safeguarding costs associated with the complexity of product descriptions. Auctions enable the digital representation of products and fix most aspects of the purchase contract, so sellers face reduced coordination costs associated with explaining to buyers the complexity of the recyclable materials. Hence, the findings provide strong support for **Proposition 2b**. However, it is noted that the interview data concerning the use of Web-based auctions did not indicate that the digital representation of products reduced safeguarding costs.

4.5. *Relational embeddedness*

Proposition 3a proposed that real-time data feed services reduce transaction costs since they enable trust, information sharing and joint-problem solving. As shown below, the interviews indicated that multiple wholesalers used real-time data feed services in the context of business relationships.

4.5.1. Real-time data feed services

Real-time data feed services and the abundance of publications on prices have made the recycling business more transparent, in addition to empowering market actors. Market actors are more than ever aware of current market prices. Enhanced access to price information has increased the transparency of the marketplace (Interview C, F, N, Q). A processor noted that “the LME has such a huge impact . . . on pricing. It’s very transparent” (Interview L). Even local small vendors are aware of the LME: “some guy coming up with a ten pound [of non ferrous materials] wants to know what the LME did today. That’s pretty incredible” (Interviews L1 and L2).

Greater access to market information has increased the awareness of prices among market actors to the extent that now, when they engage in a negotiation, they are able to vie for a better bargaining position. For example, price services reduce the occurrences in which traders will award price quotes which are out of sync with the current fair market price (e.g., underbidding or over-asking) (Interview L). Transparency and empowerment has increased the competition, which has “made it harder to make a living” (Interview C and

L). Traders remarked that they have to operate on decreasing, even razor-thin margins (Interviews). Increased competition and decreasing margins augment the importance of relationships, since they help wholesalers avoid costly rejections, misunderstanding and/or downgrades, which often would result in a loss to the seller.

Interdependencies between relationships and routines

The interviews provided indications that interdependencies between relationships and routines reduce negotiation and contracting costs. Wholesalers indicated that real-time data feed services improved the way they are doing business (Interview B, F, PF). Below several other examples are provided:

“Typically, [wholesalers] are looking at thirty-day contracts and try to hold thirty-day pricing. A lot of the suppliers are going to have the same grade of material and quantity approximately each month, so within the last few days of the proceeding month they. . .kind of make the rounds of talking to various consumers. They get a sense of what the price is going to be. There are price indices that will indicate a price for a commodity and. . .if they can agree on the price and the terms, they make a deal. They agree to ship x many tons of certain xyz commodity at a certain price. . .then they put the order in place and the transaction occurs over the next thirty days. Shipping occurs by rail cars or trucks. . .and creates a schedule of shipments. Typically, that whole thing is predicated by conversations that take place between the buyer and the seller at the very beginning of the month or just prior to the beginning of the month” (Interview Q-2).

“They [sales] are documented but it’s a long-standing handshake agreement based on certain pricing and these. . .are ties off from the LME or Midwest transaction price, and you know that is a consistent differential month in, month out and so we know pretty much what they’re going to pay” (Interview L).

“Because of the timeliness of communication the reaction becomes just as instantaneous. So, let’s say an aluminum smelter has a fire or some major mechanical breakdown and they were a large producer. If that happens you could almost say I read this story on 10am [about the events at the smelter]. Probably within 10 minutes if they’re trading on the London Exchange, the price will increase because it’s a perceived shortage of material” (Interview L1).

4.5.2. Email

Proposition 3a proposed that email reduces transaction costs since they enable trust, information sharing and joint-problem solving. Wholesalers use email to coordinate relationships. Also, email is used to share pictures, which enhances existing relationships and reduces safeguarding costs.

Role of relationships

Relationships are at the base of any scrap negotiation and transaction (Interview A-R). Relationships and trust between the seller and buyer are highly important for scrap transactions (Interviews A-R). As a wholesaler stated: “Any highly successful person in the scrap business will tell you that it’s a relationship business. There is no doubt about it” (Interview I). The same wholesaler explained the importance of relationships:

“The scrap business. . . is not as ‘defined,’ so to speak, as a lot of other business, so two different consumers can call a material the same thing. But, what if they’ll accept it and their plants are a little bit different in both cases, and you just get to know what that is. In order to do that, you gotta’ go to the plant, you gotta’ understand how they are melting, or how they are using the scrap. You gotta’ talk to people, you gotta’ see what they like and don’t like, all those things factor in”
(Interview I).

Another wholesaler noted that relationships provide buyers with some security and less problems down the line:

“Again, most mills don’t want to reject material and most of them don’t even want to downgrade. They want what they bought and they want it to show up when it was scheduled. They can get it in their furnace so they can make money” (Interview C).

Email and coordinating relationships

Different opinions exist about whether email has enabled buyers and sellers to make initial contact. Some wholesalers claim relationships enable the use of email and others say the opposite. For example, a wholesaler mentioned that email “is just a tool of communicating for people where they’ve already established the relationship” (Interview F-1). Another wholesaler stated: “You don’t build relationships with emails” (Interview L). Another market actor stated the following:

“There is the existing pattern, or level of business relationship, existing levels of trust. The Internet is not going to replace that at all, it’s impossible. [Email] supports the transaction to be more smooth. Instead of sending things by the post, people can . . . send out contacts out by email or receive prices more up-to-date, like instead of getting it by the newspaper every week you can get it everyday electronically” (Interview R).

Email is also woven into the information exchange between business partners. For example, email is used to negotiate specific deals: “Email negotiations [for example, where trading partners say] ‘give me this price’ and they come back with another price,

whatever the case may be. Now, you still need communication because it's important to get a feel for where the market's going" (Interview Q).

Limitations of email in relationships

Several wholesalers raised some critical questions regarding the use of email. For example, one wholesaler mentioned that a digital picture and a test load can never provide 100% assurance that the buyer gets what they thought they would get (Interview H). This shows that email complements existing business relationships, but does not replace relationships or act as a substitute. Email in this case helps reduce specific coordination costs. Another wholesaler noted:

"Oh no, there is a lot of email communication, but I would say that the majority of the metal we sell is still done. . . by phone. I mean, we are still talking to people and making deals like that" (Interview I).

Email and safeguarding relationships

A wholesaler indicated that after-sales issues are pretty common in the scrap business:

"And then of course you get to issues that need to get resolution to them. It is a lot easier to resolve something with somebody that you got a relationship with versus somebody you never talked to before. Well there is always going to be issues here and there. Our company is pretty big--we ship out a lot of material. There is always some small issues here and there, and those are best resolved between entities which have a relationship" (Interview I).

The sharing of digital pictures by email also enables faster and more satisfying identification and resolution of specific problems identified by the buyer, concerning the content and quality of materials. For example, a wholesaler stated that “in some cases [you can] send these reports [of metallurgic analysis] by email, if you have a problem” (Interview F). Another wholesaler had this to say about such instances:

“If they [consumers] can get that information [of the buyer’s complaint] back to you quickly, maybe that same day, then that solves the problem for the next time, and that’s really what they’re trying to accomplish. So, the Internet has decreased the time of when you have a problem to knowing what that problem is and being able to see what that problem is and being able to understand how that problem may have been created at your plant, so you can get at the cause, rather than just trying to figure out what that mill might have been saying. It takes away a lot of the frustration and it takes away a lot of the finger-pointing throughout the entire supply chain. Whenever you can get that information back quickly, then it becomes a material discussion rather than, you know, who screwed up” (Interview C).

The exchange of pictures by email enables faster and more comprehensive interactions to pinpoint a specific problem with the materials. A wholesaler also noted that email provides incentives to quicker inform or consult the seller concerning a specific sale (Interview C). Furthermore, email and the ability to exchange digital pictures enable the seller to quickly resolve problems, which ensures that “small issues/problems will not get out of hand” (Interview C). Alternatively, as the wholesaler put it:

“Twenty years ago everything would have been done over the phone or through a sample on any exception. The mill would have found a problem. They would have taken a very bad Polaroid picture and tried to mail it to you. They would have grabbed a bunch of stuff, put it in a sample and sent it to you. Today, they would just say I can’t really explain it to you, you’ve got a problem, it’s a downgrade or a rejection, and I will follow up with pictures” (Interview C).

Thus, email with digital pictures enables sellers to pinpoint the specific issues with specific purchased materials (Interview), thus enabling the seller to make a quicker, more-informed response to resolve the issues. Therefore, buyers’ concerns and problems encountered with the purchased materials are less likely to disrupt transactions (e.g., costly rejections), jeopardizes relationships or lead to conflict.

Overview

Thus, findings provide strong direct and marginal support that the use of communication-like Internet tools reduces transaction costs, enabling trust, information sharing and joint problem-solving. The support for Proposition 3a is split between the two studied communication-like Internet tools, although these tools only differ in regards to the strength of the evidence, not the direction. First, we have indirect evidence that real-time data feed services reduce (potential) tensions between trading partners and contribute to information exchange, both reducing coordination and safeguarding costs. However, the interview data presented above concerning the use and effect of real-time data feed services does provide indirect evidence to marginally sustain **Proposition 3a**. Second,

we can conclude that email enhances and maintains relationships and in effect reduces coordination and safeguarding costs. Hence, the findings provide strong support for **Proposition 3a**, since email use improves trust, information sharing and joint-problem solving, which reduces transaction costs.

4.5.3. Auction use

Proposition 3b proposed that Web-based auctions (brokerage-like Internet tools) increase coordination and safeguarding costs, since they reduce trust, information sharing and joint-problem solving.

Reduction of social pressure from business relationships

An auction seller noted that the auction protects him from the social pressure of potential buyers to be more flexible in pricing (Interview D). Social pressure through reciprocity was exercised by potential buyers who had by accident received information about certain favorable prices awarded to other buyers. Favorable prices may be awarded because of long-term relationships, high volume reducing contracting costs, or the seller needing to sell the material faster than normal (Interviews). As one interviewee noted:

“One should never look in another mans pocketbook. So therefore, sometimes you don’t understand how someone can come up with prices like they have. [You should] not assume you’re playing on a level playing field. The assumption is everyone will behave in a professional manner does not mean that’s the case reality-wise out there. If you sell to somebody on a recovery basis, they may process it and not give you the correct results. And, vice versa, somebody [may] ship a lesser quality material than what’s advertised” (Interview Q).

The seller noted that one of the buyers to whom he gave a good deal in the past might have bragged among his colleagues about a relatively low price he had paid to the seller for a particular shipment. Such information may be picked up by other buyers and used against the seller (Interview D). For example, the informed buyer may question why he does not get a favorable price. The seller noted that the use of auctions released him from such social pressure from buyers and stated “I am not the bad guy anymore,” when buyers bid higher than expected.

Hence, the findings based on the interviews with auction sellers provide indications that do not support **Proposition 3b** in instances where Web-based auctions reduce transaction costs associated with social pressure and reciprocity exerted by buyers, who had gained access to sensitive information through an informal social network.

Current auction sellers and relationships

The interviewed auction sellers perceive the auction as complementary and not disrupting of existing business relationships or cannibalizing their main business (Interview N). The auction sales are only conducted for a very narrow market and account only a fraction of their sales (Interviews D, I, N). Current sellers on the auction continue to rely for the most part on existing business relationships to conduct trade (Interview D, I and N). A wholesaler selling on the auction argued that the auction was not changing the role of wholesalers or making relationships less important. He stated that: “Quite frankly, the auction is just like any other tool [Curlee, 1986 #494] the Internet will never replace

existing business practices” (Interview N). The same wholesaler argued further that the auction was not disintermediating the role of the processor in any regards.

Role of business relationships in conventional negotiations

Business relationships are the lubricant of the recycling industry since they reduce safeguarding costs. They form the basis of informal contact handshake contracts, which are a way to mitigate high transaction costs and market uncertainty. Existing business relationships smooth the trade of recyclable materials by building trust and ease of partner selection, reducing effects of price fluctuation, lessening the uncertainty of material composition, ensuring that materials are moved from the shop floor of material wholesalers and reducing the risks that a transaction will be downgraded or rejected (Interviews A-N). The recycling industry is characterized by a close-knit infrastructure of informal business relationships and self-enforced reputation mechanisms, facilitating the complex trade of scrap commodities.

Relations reduce the costs of safeguarding at auctions

Remarkably, the interviews with auction sellers indicate that relationships continue to play an important role in an auction environment, as shown by the following quotes:

“Then you are just trying to make sure you are dealing with somebody reputable, who says they are going to buy, that they are going to supply you with ten to twenty containers at different locations to load up materials, that the containers show up, and that when they are loaded they are going to come up, and take them

once the cash arrives. So that is basically what you are looking for in that type of situation” (Interview I).

“But what do they know about this guy? Well, that’s why they sell it FOB shipping point and cash in advance because it doesn’t matter as long as the item is what they claim it to be. They also allow potential buyers who are going to bid on the scrap items to come to their office or yard and inspect the material where it’s at” (Interview Q).

“Now, they [sellers] always have their own regular buyers that they encourage to utilize [the auction] to bid on the scrap (Interview Q).

Table 8: Skeptics’ reactions when asked about Web-based auction use

Number of firms	Feelings/concerns
Many	“Is not the way we do business”
Many	“It is all about relationships”
Some	“We hate auctions”
Some	“We don’t do e-business”
Some	“If they do that [use the auction] than I will not deal with them anymore”

Formal and non-users: Auction threats, jeopardizes and destroys relationships

A large number of the interviewed wholesalers were skeptical of the auction, being reluctant to put materials up for sale. Many managers gave outspoken and skeptical views of the (potential) use and effects of Web-based auctions (Table 8). Wholesalers overwhelmingly argued that the negative effects of Web-based auctions on existing relationships are the main reasons why they are reluctant to use them (Interviews A, B, C, E, F . G, J, O, P). These wholesalers almost unanimously viewed Web-based auctions as a mechanism which undermines, jeopardizes, weakens or even destroys existing business relationships. Wholesalers also argue that the auction is in conflict with their way of doing business, in the context of relationships. Even a wholesaler selling at the auction stated that he “prefer[ed] to do business through negotiations” (Interview I).

Beyond price

There are several characteristics related to the way an online auction works that fuel the skepticism of wholesalers, for example, the threat they pose to business relationships. First, the sole negotiation criteria of auctions are perceived to be price and the fact that you don’t know with whom you are dealing. Wholesalers argued that the trade of recyclable materials is much more than only price, such as quality assessments and guarantees, compliance with agreed upon arrangements and contract specifications, joint-planning, information exchange and trust.

A wholesaler provided pretty harsh criticism when discussing auctions (Interview O). He noted that the auctions organized by large generators incite bids from which it is almost

impossible to generate a profit. The processor mentioned that the prices offered were higher than he would get for the materials when processed and prepared for shipment. In his view, auctions (in general) focused too much on price and were used as a mechanism to squeeze the profit of wholesalers to abnormal levels. He stressed the importance of other issues, which make or break a deal, such as the quality of materials, customization and regularity of collection of materials. These issues were neglected, in favor of price in cases, where auctions were deployed.

Uncertainty about behavior of the buyer

Sellers face greater uncertainty about the future behavior of the buyers while using auctions, in comparison to negotiations. For example, sellers are unable to ascertain the chance that a buyer will reject or downgrade the load. Furthermore, wholesalers face uncertainty about the willingness of the buyer to jointly resolve potential problems. Since the buyer is unknown from the onset of the auctions, the reputation of the buyer will not affect his/her ability to bid successfully for a load of material. Buyers and sellers who do not know each other often lack trust and incentives for reciprocal behavior, which normally provide some aid in resolving potential problems down the line (Interviews).

Lack of opportunities to build trust

Auction sales are awarded more or less randomly. Therefore, there is a lack of opportunities to build trust, reciprocity, goodwill and reputation. These relational mechanisms are regarded by wholesalers as essential to add values, negotiations, joint problem solving (e.g., downgrades) and information sharing (e.g., to get an indication of

prices) (Interviews). A representative of an industry association stated: “It’s the relationship, and the trust issue that doesn’t happen overnight” (Interview R). Wholesalers also indirectly suggested that auctions reduce the willingness of partners to grant each other “favors” and exchange information (Interviews). As one wholesaler noted about reciprocity: “Everybody talks about that [reciprocity, but] you never really know how good you are being treated until you are having a problem” (Interview F).

Inability to customize materials

Trust, reciprocity and joint problem solving enable wholesalers to customize and add value to the processing and preparations of materials. Customization reduces the cost for consumers (buyers) and increases their convenience and satisfaction (Interviews). Since buyers on auctions are not known in advance, the opportunities to customize materials for the buyers are greatly reduced and thus the opportunities to add value and get a higher price for the materials up for sale (Interviews).

Inability to develop and create markets jointly

Auctions also inhibit the possibility of jointly developing markets and engaging in joint-problem solving, which are important means to increase revenue and add value to a transaction (Interviews B, C, F, I, J, L, N). Relationships and good business contacts are important to create, develop and sustain markets for (specialized) recyclable materials. The joint development of new markets and products requires a large amount of communications and interactions, which are facilitated by mutual trust and belief in a win-win situation (Interview L and N).

Overview

The findings show that Web-based auctions tend to increase safeguarding costs. Hence, the findings provide strong but partial support for **Proposition 3b** concerning the fact that brokerage-like Internet tools increase safeguarding costs, since they reduce trust, information sharing and joint problem solving. However, the effects of Web-based auctions on coordination costs are contradictory. First, the few recyclable material wholesalers using the auction perceive a decrease in two types of coordination costs such as search and price discovery costs. This decrease is accomplished only for a specific niche product category and specification of the auction sale. Second, many non-users, previous users, and some current users of Web-based auctions perceive an increase in other types of coordination costs concerning the majority of nonferrous scrap sales, such as determining product offerings and negotiation costs. Hence, the findings provide mixed evidence for the other part of **Proposition 3b**, regarding the statement that brokerage-like Internet tools increase coordination costs, since they reduce trust, information sharing and joint problem solving.

4.6. *Joint planning and demand variability*

4.6.1. Real-time data feed services

Proposition 4a proposed that the use of real-time data feed services enables joint planning, which reduces transaction costs associated with the variability of demand. Several wholesalers indicated that they used real-time data feed services to jointly plan production. For example, wholesalers indicated that online price service help set the parameters of negotiated (long-term) purchase contracts with buyers such as foundries and minimills, since prices are tied in with published online price indices. This reduces their exposure to price fluctuations, since they can buy call or place options to lock in their profit (Interviews C, H, L), as also discussed above.

4.6.2. Email

Proposition 4a proposed that the use of communication-like Internet tools enables joint planning, which reduces transaction costs associated with the variability of demand. The interviews with the wholesalers show that multiple wholesalers use email to distribute calls for proposals or so-called email broadcasts of purchase contracts. Email broadcasts seem to be used by buyers and sellers with existing business relationships. As a wholesaler noted: “There’s some of the information communicated certainly via email. Some consumers will put out their monthly purchase order via the Internet. That is just a tool of communicating for people where they have already established the relationship” (Interview F-1). Another wholesaler also indicated the importance of relationships in the

context of email broadcasts: “Now, these two companies [who send out email broadcasts] don’t do the same things exactly. They may buy some of the same material, but they’re a totally different process” (Interview L).

Overview real-time data feed services and email on demand variability

Hence the findings provide modest support for **Proposition 4a**. First, the use of real-time data feed services decreases coordination and safeguarding costs associated with joint planning between recyclable material wholesalers selling scrap metals and the firms buying the materials (e.g., minimills and foundries). For example, real-time data feed services take a certain degree of price uncertainty out of a transaction or purchase contracts that are tied into an industry price index. Therefore, firms selling nonferrous scrap metals are less concerned about a buyer potentially underpaying. Second, the interviews show that email use such as email broadcasts of purchase contracts help some wholesalers reduce transaction costs associated with joint planning.

4.6.3. Auction use

Proposition 4b proposed that the use of brokerage-like Internet tools increases transaction costs associated with the variability of demand. One auction user was slightly concerned about the issue, while demand uncertainty in relation to Web-based auctions was mentioned multiple times by wholesalers who did not use them.

Auction users

A seller noted that his use of the auction also posed some challenges concerning downward or upward price fluctuations. For each auction, the seller needs time to organize, announcing it to potential bidders in advance to enable an effective marketing campaign and increase the number of bidders. Auctions are normally announced a month in advance (Interview Q and D). It may happen that after the seller's announcement of an auction sale, prices will rapidly decline. In such circumstances, the seller may of course stick to the reserve bid, which is related to the price level before the price shock. Sticking to the reserve price was the preferred option of the seller, but the seller is in such a case not likely to offload his materials.

"Copper is one of the most volatile markets, depending on what day price it is. This week it is way up, last week it was probably 5 almost 10 cents different from this week. So if you would have sold last week and here it is this week that you would sell. Then with the auction, and that is what I am concerned about is that I can set up the auction a month or a week from now or whatever, but then my concern is about missing my market. Like now, we can sell copper, it stakes a run

up [and you want to] take advantage of it. You know, it will probably go down typically" (Interview D).

This situation shows some challenges faced by sellers. For example, the seller who was interviewed recognized that he was limited in his ability to take the materials off the auction and then try to quickly sell the load of materials on the spot market. Such behavior would be considered as inconsistent by the buyers, since the seller had already committed the materials to the auction and closed off the other sales channel (namely selling on the spot market through negotiations). In effect, such behavior would increase uncertainty among buyers as far as to which channel the seller would allocate the sale, making buyers less aggressive, or leading to discouragement from using the auction in the first place.

Non-users: Auction sellers cannot predict in advance who will buy their materials

Auctions reduce the transaction solely to the price, and therefore auction sellers are inclined to switch buyers, depending on who is the highest bidder. Getting the highest price at the cost of relationships goes against the way wholesalers do business. Sellers switching buyers will jeopardize existing business relations (Interviews). The idea of jeopardizing their existing long-term relationships violates many things a processor stands for and is something viewed as not done (Interviews). Wholesalers argued that the use of an auction increases the uncertainty among buyers. Auction sellers limit the access to supply for specific relationships, so buyers can no longer rely on a seller to deliver

materials Relationships enable wholesalers to secure demand, to provide opportunities to customize and add value (Interviews).

Non-users: Ability to sell materials

Wholesalers are uncertain about the number of buyers and whether or not they are able to sell their materials in the first place. Wholesalers argue that at current price levels the number of buyers might be enough. However, wholesalers worry that in periods when prices are dropping sharply or fluctuate constantly or rapidly there will not be enough buyers to close a deal for the materials up for sale (Interviews). Wholesalers would then not be able to move the materials from their scrap yards with limited storage capacity (Interview L). Lack of buyers' interest increases because sellers are not able to establish a relationship through an auction that is needed to reinforce a buyer's commitment to purchase materials in both bad and good times. Relationships have traditionally provided greater security of demand during price shocks and periods with relatively low prices (Interviews). A wholesaler stated it in the following way:

"Now, pricing changes. If you try to hold an auction for your material every month, now assume material is really needed and it's in demand. You know, you could probably end up doing that, but when maybe, say, it isn't as much in demand and you do that, you have people that probably wouldn't even want to do business with you. If you weren't here when we really needed you why should I be here when, you know. You try to build relationships, but it's a tough business. It's not an easy business by any stretch. It's extremely competitive" (Interview L).

Retaliation

Wholesalers also argued for a potential retaliation by market actors towards sellers who switched buyers in favor of short-term gains (thus by using an auction to get a higher price) (Interview). In times when the seller has to fall back to its known business contacts (e.g., periods with price shocks or relatively low prices), the seller may need to reestablish the link with a formal buyer whose relationship was discontinued in favor of spot market/auction buyers (Interview PF). The social costs to accomplish the reestablishment are relatively high. For example, a seller may be confronted with questions from the buyer: “Why have you not sold to me lately?” (Interview PF). Such questions would cause feelings of shame and would put the seller in a difficult situation. The thought of such humiliating situations to reestablish a relationship were for some prohibitive against changing trading partners and using auctions to get a higher price in the short run (Interviews PF and E). Another wholesaler argued that if people came back to him after using a Web-based auction he indicated that he would say that these firms should go back to their auction friends. During the interview, he used an offensive word concerning such firms making use of the auction (Interview E).

Overview demand variability and joint planning

Hence, the findings of users and non-users of Web-based auctions strong provide support for **Proposition 4b** since the use of auctions increase coordination and safeguarding costs associated with demand variability.

4.7. *Inter-organizational routines*

4.7.1. Real-time data feed services

Proposition 5a proposed that real-time data feed services enhance existing industry-wide exchange routines and thus reduce transaction costs. Multiple wholesalers indicated that they use real-time data feed services as part of their routine.

A visit to a conference of the Institute of Scrap Recycling Industries, Inc. on scrap commodities illustrated how checking prices of scrap metal has become a routine for recyclable material wholesalers. Visitors such as traders, managers and owners often congregated around an exhibitor stand that provided real-time access to the price information of the major commodity exchanges. Wholesalers checked the computer screen multiple times to see what “prices were doing” on the exchanges (Interviews G). Checking the prices of the main commodity exchanges has become routine for sellers. Also, real-time data feed services are relatively easy to implement technically; firms only need a computer or handheld device with Internet access (Interview A, H). Real-time price services enable traders to be continuously updated on prices, even when they are on the road meeting clients, visiting customers, etc. The price services allow traders to work more efficiently, effectively and allows them to do more business in less time (Interview C, L). As stated earlier, traders are “expected to do more in less time all the time” (Interview C). Earlier, we discussed the fact that wholesalers often employ specific premiums to exchange prices, to help determine prices for specific scrap materials.

Multiple wholesalers discussed this issue and its application. For example, an interviewee noted that scrap processors get prices for their material in the form of “a premium from the LME” (Interview Q-2).

4.7.2. Email

Proposition 5a proposed that email enhances existing industry-wide exchange routines and reduces transaction costs. Many wholesalers used email to conduct business as part of their daily routine.

The interviews indicate that email is perceived as a natural extension of fax and phone and has resulted in faster, and more detailed comprehensive communications and exchanges (Interviews). Furthermore, email greatly eases the management of multiple clients in different situations. Overall, there are indications that email reduces both coordination and safeguarding costs, providing wholesalers with incentives for its use. Emailing pictures has become part of the routine of negotiation activities for wholesalers.

“We send email, we’ll attach pictures and show them exactly what the material is and represented as the photos describe. Sometimes those photos are generic and they vary little from load to load, but usually they are, if we have a specific product that we want to sell today, we take a picture and say, ‘this is the product I’m selling you.’ It’s become standard practice over the last few years as the email and digital cameras have become more available. I don’t know what I’d do without my email and my pictures today” (Interview I-1).

Certain trade activities seem to be affected by email use, although wholesalers do not show any resistance or criticism to the use of email. For example, a wholesaler noted: “It is a tool like the telephone, but it’s not the methodology” (Interview F-1). The effects of email on the way people do business are incremental. For example, the exchange of digital pictures of materials up for sale incited incremental changes of business practices and trading routines. Email makes existing trading activities and transactions more efficient, by speeding up communication, reducing the chance of errors, and so on, which reduces coordination and safeguarding costs. The communication capabilities of email match to a relatively high degree with inter-organizational exchange properties. For example, email provides recycling firms with a tool that is viewed as complementary to their way of doing business and conducting trade. Email also enables firms to evolve existing trading activities, such as sending a digital picture instead of a test load of recyclable materials.

Worries about email spam

Wholesalers did not mention any critical notes on the use of email except the fact that they receive lots of email spam (Interviews Q). Email spam is regarded as a great annoyance (Interview PF). Spam also disrupts normal business routines, since wholesalers have to skim and sort lots of irrelevant email, which reduces the usability of email (Interviews). Overall, there are some drawbacks, but buyers perceive them more as an annoyance than a threat; this may nevertheless limit the reduction of coordination and safeguarding costs accomplished by the use of email.

Overview communication-like Internet tools

It is common business practice to be at all times brought up-to-date regarding the market prices of recyclable materials. Furthermore, real-time data feed services strengthen the common rule-of-thumb routine that prices are tied into specific exchange prices. Also, real-time data feed services reduce the costs of assessing the price quotes of buyers. Second, the interviews show that email has become part of the daily business routine of traders. However, some wholesalers mentioned that email spam marginally reduced the utility of email, thus contradicting earlier findings. However, the overall findings provide strong support for **Proposition 5a**, since both the use of real-time data feed services and email enhances existing industry-wide exchange routines and reduces transaction costs.

4.7.3. Auction use

Proposition 5b proposed that brokerage-like Internet tools (e.g., Web-based auctions) dislodge existing inter-organizational exchange routines, thereby increasing transaction costs. Two auction sellers argued that the auction introduces new routines, but that the Internet would not replace existing inter-organizational routines. One auction seller argued that he helped other wholesalers to master the new routines to engage in the online auction.

Wholesalers seem to still be unfamiliar with the “how-to” and the benefits of Web-based auctions. For example, a seller on the Web-based auction informed several colleagues that had contacted him about how to use the auction. Several colleagues had asked him to show them how the auction worked, which he agreed to do (Interview D). Buyers need to

be careful not to get too carried away in bidding and “getting too greedy” (Interview D). Buyers must be willing and able to grant another buyer the sale when prices go up too high to avoid overbidding (Interviews). A seller noted that sometimes bidders got carried away and offered higher prices than they normally would (Interview J). Or, as a wholesaler stated: “Not willing to let other buyers to get the sale, or granting a sale to another buyer” (Interview D).

A processor noted that the cost of submitting a proposal online can be very high in comparison to the size of the deal (Interview PF). The processor mentioned further that he had great difficulties in getting all the information collected which he needed in order to fill out the required fields of the online form. It was so complex he had to ask the assistance of his financial accountant to gather and submit the required information. Thus, the cost of organizing and submitting the required information was unbalanced in relation to the small amount of material covered by the contract. He noted that he did not plan to participate in any of these online tenders in the future.

Overview inter-organizational routines

Hence, the interviews provide reasonable support for **Proposition 5b**, that Web-based auctions dislodge existing inter-organizational exchange routines, which increases transaction costs.

4.8. **Structuration of the use of Internet tools**

4.8.1. Real-time data feed services

Proposition 6 states that firms who use those Internet tools, whose capabilities match the interdependencies between two or more properties of inter-organizational exchange, reduce their transaction costs. Below I discuss the way multiple wholesalers perceived this match between inter-organizational exchange properties and the use of real-time data feed services.

Match with existing ways of doing business

Even though real-time data feed services are important to discover a price, relationships and trust continue to be of crucial importance within every scrap transaction (Interviews), since many other dimensions beyond price of a transaction are important. As one wholesaler put it, “it’s all about relationships” (Interview K). For example, a wholesaler noted that when a buyer decides to buy a specific load of scrap based on the COMEX, he takes the following actions:

“We would go about preparing it according to his specifications, scheduling it when he wants it, shipping it the way he wants it, and delivering it to his plant. We’d do an oral contract and he’d follow up with a written contract and that order may be priced or unpriced. It may either be a formula price or it may be a fixed price” (Interview C).

Still, the sellers need to assess the financial standing of sellers, level of services and what a fair price would be (Interview N, F, L, H). Relationships are important to determine a fair market for the materials up for sale (Interview L). Furthermore, wholesalers point out that within a relationship they can better learn and anticipate the specifics needs and routines of a buyer (Interview C, B, J, L, N). Relationships provide ways to learn the buyers' routines:

"Each consumer develops their own specification and it may be formal or informal. It may be well understood or maybe a bit sketchy, but over a period of time if your material is going to go where it makes sense to go, there's going to be knowledge of what they expect" (Interview C).

Relationships are also important to share information and address specific needs of customers, thereby enabling wholesalers to add value. An interviewed firm indicated that real-time data feed services empowered wholesalers while not disrupting existing ways of doing business:

"Well, like I said it's a small world with the emails and the phones and everything else today. Not very many people get picked off as far as pricing goes. Everybody knows about what the values are. Are their specialty deals being made because of demand? Yes. Is there anything underhanded about it? No. It's just a business deal when somebody needs a product that somebody has that they know that they've had X number of times. Rather than going out and trying to piece them together and having to ultimately pay more money for it, they would offer a deal to buy a large tonnage of material" (Interview I-1).

Hedging activities

Proposition 6 proposed that structuration of the use of the capabilities of Internet tools can improve the match with the exchange properties and interdependencies and as a result can reduce transaction costs. Wholesalers provided several instances in which structuration of technology use had occurred.

Wholesalers use real-time data feed services in conjunction with electronic trading software to execute trades on commodity exchanges, sometimes through making use of software packages provided by brokers (Interview A, H, C, L, K). Recyclable materials wholesalers perform regular hedging activities with the primary market of commodities to cover/secure transactions of recyclable materials. Wholesalers are not like speculators who bet on price fluctuations (Interview H and L). As a wholesaler noted: “We are trying to increase production so we can cover the costs of labor and other activities. Speculation is not the nature of our business. We try to buy and sell as fast as possible to increase our production volume” (Interview L). Often, hedging costs are too cost prohibitive to perform a hedge for every transaction (Interview C and J). Still, the number of outstanding transactions can be rather large, so the unhedged risk can become rather large (Interview H). Wholesalers deal with these risks on a day-to-day basis and resign themselves to common interpretations of doing business in the scrap industry, such as “sometimes you win or you lose” (Interview H and L). Wholesalers “love what they are doing” (Interview J), and “you need to have the stomach” (Interview H) to deal with the prices risks, uncertainties and fluctuations, in a way that enables market actors to continue to do business within a constantly changing environment (Interview B, F, K). Many

people's livelihood depends on the ability of wholesalers to buy and sell materials (Interview H and L).

4.8.2. Email

Proposition 6 proposed that the structuration of the use of the capabilities of Internet tools can improve the match with exchange properties and interdependencies and as a result reduce transaction costs. Below a presentation follows of the findings concerning a) the structuration of email use and the establishment of relationships, and b) the structuration of email use concerning email broadcasts and exchange of digital pictures.

Email and establishment of relationships

Many wholesalers did not see email as a tool to establish new relationships. Only a few wholesalers had in fact established relationships via email. There are indications that buyers and wholesalers reinvent the use of email to try to establish relationships. However, only one wholesaler used email to do business with someone they did not know before and subsequently established relationships. When asked if they only transacted with someone by email with an established relationship and face-to-face contact he answered:

"No, not necessarily. I've dealt with an individual from China for nearly two years before we ever talked on the phone. [We initiated correspondence] by email" (Interview I-1).

However, many wholesalers were critical of the use of email to establish relationships. Email seems to be used by buyers to gain access to new sources of supply. Many wholesalers noted that “new people pop up all the time” (Interview N, J, H). Wholesalers noticed that they get more and more business proposals by email. However, they express concern in regards to after-sales issues which may arise and this prevents them from taking up such sales leads. For example, a wholesaler noted the following:

“And these emails that come soliciting buying material. By and large none of them are domestic. . .they’re Middle Eastern, African. . . not even Chinese. It’s more [other] Asian countries or African. Again, why would we want to sell if they’re not willing to pay premiums above what we’re already getting. It’s not because they’re nice guys or anything. There’s no contest we’re entering or lottery to win if we sell to them. There’s no incentive at all. We’d rather go for something we feel is a lot more safe. And too, so if it’s a problem, all it costs us is the freight to bring it back. We could be out 400 to 1,000 dollars in lost freight bringing it back to our own facilities. We don’t agree with that and doing it that way” (Interview L).

People receive business proposals from firms located around the globe (e.g., the Philippines), which are not relevant for the recyclable material wholesalers, mostly because wholesalers (the sellers) are already satisfied with existing buyers (Interviews C, L). The potential buyer from developing countries may offer a few cents more per pound, “but who am I going to trust,” stated one wholesaler (Interview L). Also, shifting from trusted to new buyers may be quite challenging. First, the new buyer cannot be trusted,

and transacting with them may result in costly downgrades or rejections (Interview E, B). Second, existing buyers may refuse to deal with the seller on future occasions (Interview E, P). Wholesalers also noticed more inquiries by email from developing countries (Interview C, L, F, PF). A wholesaler had this to say:

“Before we had the Internet as a tool and the telephone, you would get phone calls from people from China as well, and you also had the snail mail that used to come in the mail. So, email is sort of the same way: you get a lot of junk email from a lot of people who really aren’t in a position to buy; they’re just making a lot of inquiries because they’re trying to find new homes or they’re trying to find a new way to get into the business” (Interview C).

Email broadcasts and digital pictures

The use of email broadcasts and digital pictures also indicate the structuration of the use of email, as discussed above. For example, email broadcasts are used by buyers as a brokerage-like tool to initiate concurrent negotiations with sellers. Email broadcasts help reduce the coordination costs of sellers.

Moreover, email makes it possible to modify existing trading activities (e.g., sending a test load, handling complaints of buyers), which reduces both coordination and safeguarding costs. For example, the exchange of digital pictures by email enables buyers to make a quicker assessment of the quality and other characteristics of the loads of scrap for sale, in comparison to sending a test load or a company visit (Interviews). The

exchange of digital pictures by email is currently a common business practice enabling firms to reduce coordination and safeguarding costs (Interviews).

Email substitutes existing trading activities and transactions (e.g., sending pictures instead of sending a test load, or the use of email broadcasts) but also complements activities (e.g., sellers interact with buyers over the phone and email concurrently). Email complements ongoing interactions (mainly by phone and fax) with new and improved capabilities (e.g., exchanging digital pictures and translated documents). Email use supplements and strengthens ongoing trade activities and create new business opportunities concerning exchange with new buyers. Email capabilities such as the use of digital pictures, price updates, translated documents and broadcasting can be considered as the structuration of the use of the capabilities of email which enable the reduction of transaction costs associated with multiple exchange properties and interdependencies. It can be argued that it is difficult to reinvent a general-purpose tool but that the structuration of Internet tool use goes beyond reinvention. Instead, communication-like tools create new possibilities to communicate over electronic networks. These new possibilities do not have to be adopted because of critical mass. Rather, email use is modified and enhanced by technological capabilities, which are implemented on an industry-wide scale, its use providing a better fit with the way of doing business and reducing both coordination and safeguarding costs.

4.8.3. Auction use

Proposition 6 proposed that the structuration of the use of Internet tools can improve their match with exchange properties and interdependencies and as a result reduce transaction costs. First, an auction seller continued his specific routine to sell his material in small batches at the auction. However, after a while he changed his use of auctions by selling his materials all at once at the auctions. Second, formal auction users criticized the fact that auctions also led to negotiations if the reserve price of the seller was not met, which was regarded as strategic behavior on the part of the sellers.

Seller's introduction of new selling strategy

A seller noted that he experimented with different auction selling strategies to make buyers more aggressive and to optimize prices. As many others, the seller tried first to sell small loads of scrap on the auctions to test the auction, to get a feeling for auctioning-off materials, and to gain knowledge on the results it would generate, such as prices, number of bids, number of buyers, etc. The test sales did provide him with satisfactory results, but did not lead to any prices above expectations. The wholesaler noticed, though, that many potential buyers were contacting him directly to buy materials through conventional means, namely bilateral negotiations, and were trying to avoid using the auction altogether.

Based on his experience and business sense the seller decided that he would try something different with the auction. The seller discontinued selling small batches on the auction, as well as selling materials through conventional negotiations. Instead, the

wholesaler put all the material he had available each month up for auction at once. In addition, he would refer buyers, who contacted him directly to buy the materials through conventional means, to the auction “If you want to buy the material just bid at the auction” (Interview D).

“We were shipping at that time about 20-25 loads a month in total. When buyers know that they are only bidding on a limited amount of loads, they are not that aggressive. A year later, when I got into selling nonferrous and this was brought to my attention. I put the majority of the material on the site for sale. Then they realized for them to buy they had to buy it at the auction. That is one thing to tell. If they [buyers] know that you are only putting a little selling a little amount, they can still go around the auction and buy it from somewhere else. They are than not as aggressive. First couple of months, nothing too exciting. He was one of the first ones who put something on it he stayed with it for a few months, to see what it would really do. By the third month it really produced much better than I thought. By giving him numbers, price-wise, was 4-5 cents more than I would normally get for the material. And that really opened my eyes” (Interview D).

The seller suspected that changing the selling strategy resulted in buyers becoming aware that they could not purchase the materials through the alternative sales channel, namely conventional negotiations. The wholesalers stated: “But the people know if that is where you going to sell your material, that makes it more aggressive” (Interview D). The seller’s introduction of a new selling strategy indicated that buyers need some time to get accustomed to and “informed” about the new way of selling and buying scrap materials.

The experience of the auction seller provides indications that auctions may need to implement new types of selling routines and strategies to make buyers more aggressive in their bidding behavior. Better results (e.g., prices of awarded sales) were achieved by bundling previously sold batches of materials, and selling them all at once. At the same time, sellers close off the alternative selling channel, namely selling outside the auction through conventional ways of doing business, namely negotiations.

Unsuccessful experiments with the auction

The wholesaler who changed his selling strategy stated that his predecessor stopped using the auction because of a lack of significant results. When the seller overtook his job, he changed the selling strategy. The seller who changed his strategy acknowledged that many sellers had not changed their strategy and had stopped using the auction after a while: “Other people did the same thing. They only put only a bit on the site for a couple of months or two. And then they quit” (Interview D). Another wholesaler made a similar comment:

“Somewhere around the turn of the century it was novel to try to do that [auctions] and a lot of people tried to do it but they had only limited success. They were novelties more than anything else as far as scrap goes” (Interview C).

Negotiations after an “unsuccessful” auction: Perceived strategic behavior

Organizers and promoters of auctions face a range of difficulties in their attempts to overcome the negative image and perceptions of auctions. An example is the emergence

of new vulnerabilities related to the perceived unfair and strategic behavior (unintended or purposeful) experienced by buyers and sellers at the auction. Auctions are not always perceived as honest. A wholesaler raised questions about how the materials being offered were rewarded. For example, a processor participated in a Web-based auction as a buyer of a load of material. The bidding was fierce and he tried to secure the supply by placing bids with prices above a level he would normally offer during negotiations. At one time, the placed bids were so high above a level where he could make a profit, that he did not place any more bids. The auction went on and was then awarded to someone else. A certain time passed after the completion of the auction. Then, to his surprise, he was contacted by the seller of the materials for which he unsuccessfully competed. The seller was asking him if he was interested in buying the load for the last bid he submitted. Apparently, the highest bidder had backed out of the agreement or was not able to follow through the deal because of financial difficulties.

The interviewed buyer was perplexed and viewed the seller's actions and proposal as unfair behavior⁵². The reason was that the seller was drawn into a bidding war and he was seduced into making a bid which was higher than he normally would have offered for the load of material (Interview J). Now that the highest bidder had backed out of the deal, the seller could still start to negotiate with other buyers. However, the bargaining power of the potential sellers was greatly reduced since they had already revealed their prices. He

⁵² It should be noted that the interviews with auction sellers did not indicate these forms of strategic behavior.

suspected that the seller was using the auction to try to solicit higher bids than normal by allowing unknown buyers to place bids. The buyer found it unfair that if any problems arose, the seller could fall back to trusted buyers who would be willing to buy. The buyer thought the seller was not accepting the risk of uncommitted buyers and dealing with unknown wholesalers. Instead, the seller transferred the risk to the buyers. His negative perception was further strengthened when he later tried the auction again, and to his surprise the same sequence of events followed. He acknowledged he was not using auctions anymore and did not plan to do so in the future.

Overview

The case studies initially provide contradictory evidence concerning **Proposition 6**. However, when taking into account the fact that recyclable material wholesalers tend to use those Internet tools which fit the interdependencies between inter-organizational exchange properties or, more concisely, "the way firms do business," the apparently contradictory findings in fact strongly support **Proposition 6**. Below a short overview is provided on how each structuration of the use of each Internet tool supports this conclusion.

Real-time data feed services. The structuration of the use of real-time data feed services provides sellers with increased possibilities to hedge their ongoing transactions in the market for primary commodities. Hedging enabled market actors to reduce coordination and safeguarding costs.. This type of use provided a good match with the way recyclable material wholesalers are doing business.

Establishing relationships through the use of email. In the majority of the cases, the structuration of the use of email did not enable sellers to establish relationships and reduce transaction costs. However, a few recyclable material wholesalers considered email as a tool that actually facilitated the establishment of business relationships. For example, as stated: “The Internet, too, creates the relationships” (Interview Q). The interviews indicate that email is predominantly used to complement existing relationships. Overall, recyclable material wholesalers indicated that establishing relationships was not pursued through the use of email, since it was a difficult match with the way they did business. It did occur in some cases, however, as indicated by the interviews.

Email and exchange of digital pictures. The exchange of pictures of scrap materials was often observed and had become part of the way recyclable materials wholesalers did business. The structuration of email use concerning digital pictures is an excellent match with other inter-organizational exchange properties. For example, email exchanges of digital images was part of the business routine in negotiations and resulted in a reduction of coordination and safeguarding costs.

Auctioning of materials and closing off market channels. Not all sellers indicated that they closed off other channels to enable buyers to purchase their materials. Such changes of selling routines by recyclable material wholesalers demonstrate that changes in use are not always imitated or reproduced, one reason

being that the closing of sales channels requires changes of inter-organizational routines, relationships and the ways prices are determined. In effect, such structurations of use are hard to match with inter-organizational exchange properties and their interdependencies. Incidentally, this can in fact be successful, as indicated by the findings and reduce transaction cost.

Perceived strategic behavior on auction sellers. The interviews of formal and non-auction users provide indications that the structuration of auction use does not match with exchange properties and interdependencies, and as a result increases transaction costs. An example is the perceived strategic, dishonest and unfair behavior of firms to renegotiate a sale after an unsuccessful auction .The auction seller interviewed did not follow such behavior and instead relied on holding a new auction altogether.

4.9. *Overview of findings*

In Figures 17, 18, 19 as well as Tables 9, 10 and 12 overviews are provided of the findings concerning the antecedents and the effects of the use of real-time data feed services, email, and Web-based auctions. In addition, Figure 20 addresses the antecedents of non-use of auctions, as well as the perceived increase of transaction costs by interviewees.

Figure 17: Sustained propositions on real-time data feed services

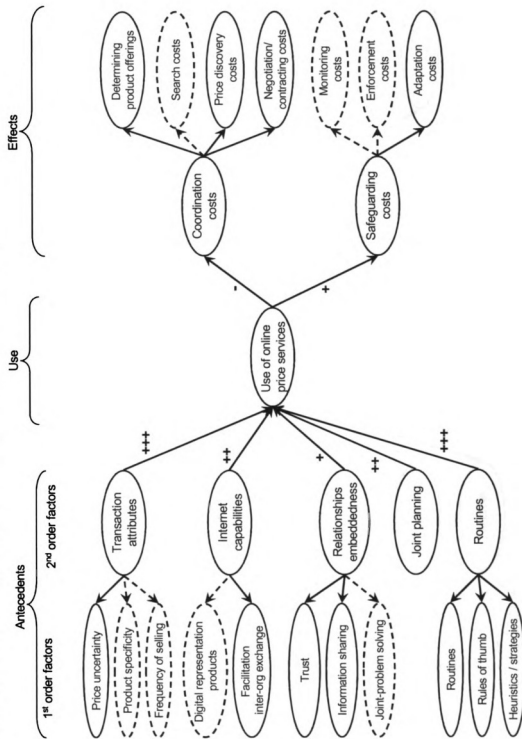


Figure 18: Sustained propositions on email use

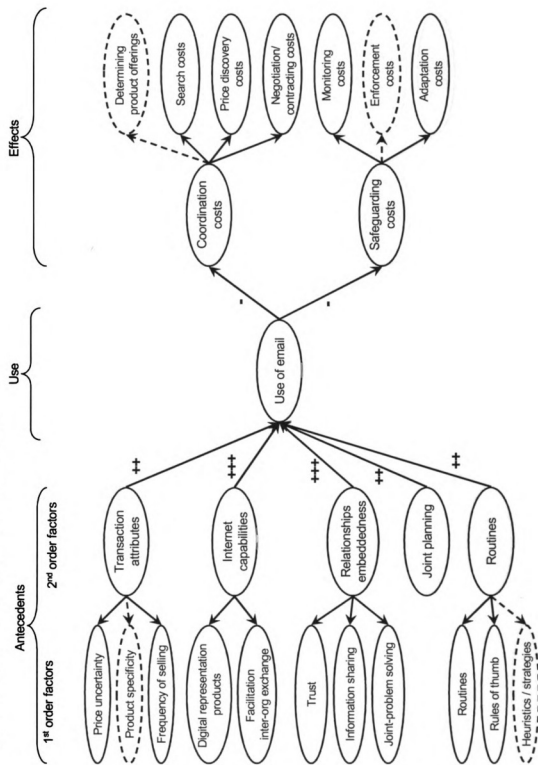


Figure 19: Sustained propositions on the use of Web-based auctions

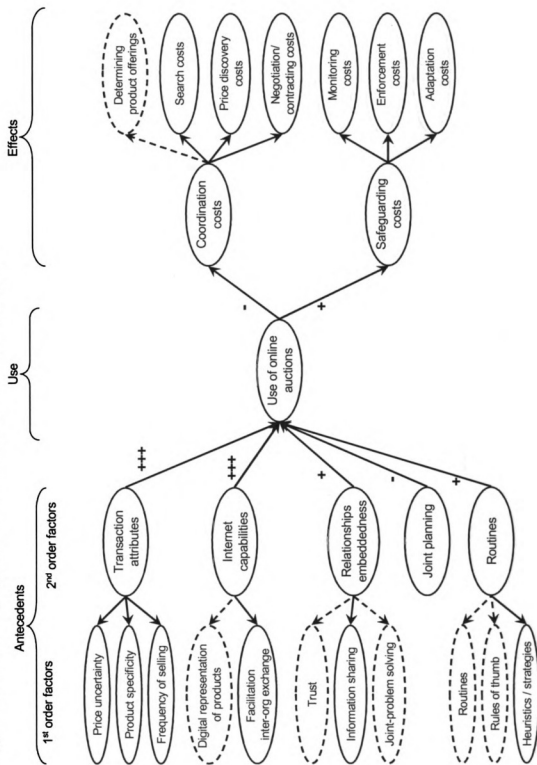


Figure 20: Sustained propositions on the non-use of Web-based auctions

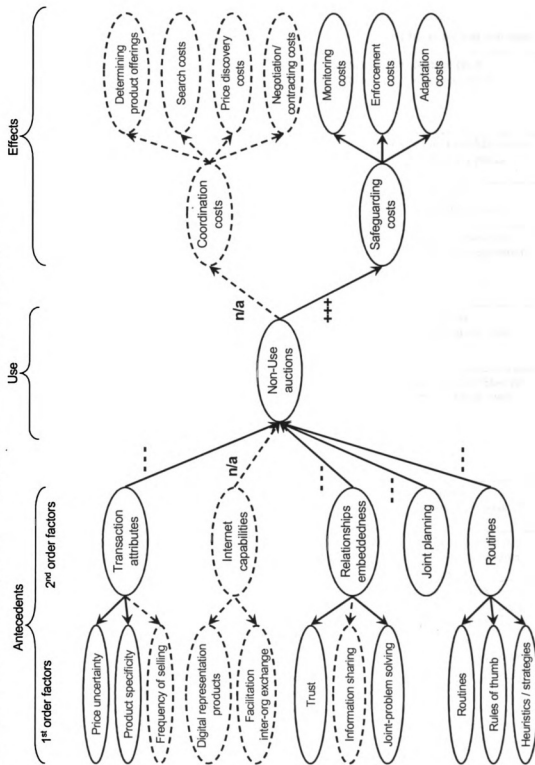


Table 9: Antecedents and effects of the use of real-time data feed services

Exchange properties	Examples of indicators	Effects transaction costs
Transaction attributes	<ul style="list-style-type: none"> • Uncertainty of prices: The price of a load of material is often negotiated with a contract that is tied in with a published price index, including a specific premium. Price information is important when entering into negotiations with consumers 	<ul style="list-style-type: none"> • Reduce price discovery costs
	<ul style="list-style-type: none"> • Assessment of product specificity continues to be important to negotiate a deal and to increase customization of materials 	<ul style="list-style-type: none"> • Continued difficulties to discover prices
Internet capabilities	<ul style="list-style-type: none"> • Hedging through the structuration of the use of real-time data feed services 	<ul style="list-style-type: none"> • Reduction coordination costs
Relational embeddedness	<ul style="list-style-type: none"> • Trust: price services reduce potential differences about underlying reference prices, but sellers still need to assess the financial standing of sellers, level of services and determine what a fair price would be for the materials up for sale 	<ul style="list-style-type: none"> • Reduction search costs, and negotiation costs
	<ul style="list-style-type: none"> • Information sharing: real-time data feed services provide continuous news updates. Such information is added by information gained from interactions with buyers and other market actors 	<ul style="list-style-type: none"> • Reduction coordination costs
	<ul style="list-style-type: none"> • Joint-problem solving: rapidly decreasing prices may cause buyers to call for price renegotiations of a deal • Some wholesalers were getting pretty upset by the suggestion that some buyers may act improperly by reporting problems with the materials to get a downgrade because of the downward price trends on the markets 	<ul style="list-style-type: none"> • Potential increase in safeguarding costs
Joint planning	<ul style="list-style-type: none"> • Indexes may be used to close contracts. Sellers may be granted the flexibility to monetize the contract at the time they think is most suitable 	<ul style="list-style-type: none"> • Reduction coordination costs
	<ul style="list-style-type: none"> • May sell things on a spot market if material is still not committed 	<ul style="list-style-type: none"> • Reduced cost to determining product offerings
Inter-organizational routines	<ul style="list-style-type: none"> • Routines (narrow sense): sellers constantly check price services since prices affect ongoing transactions and value of inventory 	<ul style="list-style-type: none"> • Reduce search, negotiation and price discovery costs
	<ul style="list-style-type: none"> • Rules of thumb: selling certain materials to specific buyers may involve a specific discount agreed upon earlier, thus enabling the seller to make a quick evaluation of the price quotes, improving the likelihood of a deal 	<ul style="list-style-type: none"> • Reduce search, negotiation and price discovery costs
	<ul style="list-style-type: none"> • Strategies: monitoring of price services may benefit strategies to hedge ongoing transactions to fix profit margin 	<ul style="list-style-type: none"> • Reduction safeguarding costs

Table 10: Antecedents and effects of the use of email

Inter-org. exchange properties	Indicators and examples	Effects
Transaction attributes	<ul style="list-style-type: none"> • Complexity of product description: emailing digital pictures of materials reduces the uncertainty about the quality, content and characteristics of the materials up for sale • Complaining buyers send description and picture of problems with the received materials, or the way materials were loaded and container number to complaining buyers 	<ul style="list-style-type: none"> • Digital pictures speed up the quality assessment by the buyer • Buyers often find pictures sufficient and often renounce a request of the shipment of a test load saving time and money • Reduction of safeguarding costs: Resolving problems quickly strengthens relationships
	<ul style="list-style-type: none"> • Product specificity: no influence observed 	<ul style="list-style-type: none"> • No effects
	<ul style="list-style-type: none"> • Frequency: buyers from China translate email messages to reduce errors and mis-understanding of the negotiations of a contract 	<ul style="list-style-type: none"> • Reduction coordination and safeguarding costs
	<ul style="list-style-type: none"> • Price uncertainty: prices exchanges received by fixed and wireless email enables wholesalers to stay up-to-date on fluctuation prices while on the road 	<ul style="list-style-type: none"> • Price information is crucial for good bargaining position and potential hedging activities/strategies
Internet capabilities	<ul style="list-style-type: none"> • Many sellers share digital pictures by email to facilitate transactions • Email is used to communicate with overseas buyers and people in different time zones • Facilitation of connectivity: email broadcasts enable distribution of information about demand and prices of consumers 	<ul style="list-style-type: none"> • Reduction coordination and safeguarding costs associated with communications over long distances • Increases speed of communication between market actors, e.g., avoidance of phone tagging to arrange shipping
Relational embeddedness	<ul style="list-style-type: none"> • Trust still needed to assess quality of emailed digital pictures • Joint-problem solving: digital pictures enable faster interaction and ability to resolve potential problems of buyer 	<ul style="list-style-type: none"> • Reduction of coordination & safeguarding costs
	<ul style="list-style-type: none"> • Receive both bids from known and unknown buyers. Filter bids from unknown buyers, since bids may be unsuitable and not interesting enough 	<ul style="list-style-type: none"> • Potential increase in coordination costs
Demand variability	<ul style="list-style-type: none"> • Improved forecasting through email broadcasts; email notifications reminders enable sellers to keep customers faster and more up-to-date of ongoing activities 	<ul style="list-style-type: none"> • Reduction of coordination costs
Inter- organizational routines	<ul style="list-style-type: none"> • Routines (narrow sense): take pictures of materials and loading of container • Rules of thumb: send digital pictures by email instead of sending a test load • Strategies: brokers save digital pictures for future purpose--to match buyers and sellers 	<ul style="list-style-type: none"> • Reduction of coordination & safeguarding costs

Table 11: Antecedents and effects of the use of Web-based auctions

Inter-org. exch. properties	Indicators	Effects
Transaction attributes	<ul style="list-style-type: none"> Complexity of product description: posting digital pictures of materials on the Web-based auction reduces the uncertainty about the quality, content and characteristics of the materials up for sale. 	<ul style="list-style-type: none"> Buyers often find pictures sufficient and thus renounce a request for the shipment of a test load, saving both time and money.
	<ul style="list-style-type: none"> Product specificity: Web-based auctions enable sellers to tap into export markets that do not need specific machines to process materials. Instead, cheap labor costs enable hand processing. 	<ul style="list-style-type: none"> Reduction of coordination costs to find buyers who are able to economically process nonferrous metals manually.
	<ul style="list-style-type: none"> Frequency: sellers use the Web-based auction only for materials they sell infrequently, and form only a small percentage of their total sales. 	<ul style="list-style-type: none"> Reduction of coordination costs to find suitable buyers.
	<ul style="list-style-type: none"> Price uncertainty: prices fluctuate, and may differ according to the need of buyers and specification of the materials. 	<ul style="list-style-type: none"> Search and negotiation costs are reduced because a greater access to potential buyers and the ability to determine who is hot.
Internet capabilities	<ul style="list-style-type: none"> Auction sellers can connect with many more potential buyers. 	<ul style="list-style-type: none"> Reduction of coordination costs, e.g., avoidance of phone conversations.
Relational embeddedness	<ul style="list-style-type: none"> Trust in buyers is hard to establish, since buyers are not known until the end of the auction sale. Joint-problem solving: the aspects of an auction sale are often set to reduce the complexity of the deal and to focus on price. However, the auction does not provide a mechanism to customize products and to develop markets together. 	<ul style="list-style-type: none"> Increase in safeguarding costs.
	<ul style="list-style-type: none"> Receive both bids from known buyers as well as unknown buyers. Filter bids from unknown buyers, since bids may be unsuitable and not interesting enough. 	<ul style="list-style-type: none"> Potential increase in coordination costs.
Demand variability	<ul style="list-style-type: none"> Demand variability: auction does not provide a mechanism for engaging in joint planning, to reduce effects of demand variability in periods of decreasing prices. 	<ul style="list-style-type: none"> Increase in safeguarding costs.
Inter-organizational routines	<ul style="list-style-type: none"> Routines (narrow sense): sellers are not accustomed to putting things up for sale on an auction, e.g., provide description. Rules of thumb: auctions change the rules of thumb, e.g., tracking the auction, picking starting price, discovering which materials sell best. Strategies: wholesaler restructured his auction use by selling all his material at once instead of in batches. However, this changes industry-wide routines, which may be regarded as inappropriate and thus jeopardize existing relationships. 	<ul style="list-style-type: none"> Increase in coordination & safeguarding costs.

5. DISCUSSION

Below the study findings are discussed in more detail. First, the antecedents of the use of the three Internet tools are discussed to understand which inter-organizational exchange properties were driving the observed use of Internet tools. Thereafter a discussion follows of the effects of the use of online price services, email and auctions on transaction costs. Third, there is a discussion of how the observations support the conceptual framework to explain the variations in the use of Internet tools. Last point discussed are the emergent issues which arose while performing the case studies concerning the social structuration of the use of Internet tools and the influence of industry-wide social norms and values.

5.1. *Antecedents of the use of Internet tools*

The literature review and findings of exploratory case studies contributed to the development of a conceptual framework linking the assumptions of TCT with those of social embeddedness (cooperation) and evolutionary economics (historical dependencies). In effect, we were able to identify and specify the antecedents into seven sets of the following inter-organizational exchange properties: Internet tools capabilities, price discovery mechanisms, transaction attributes, demand variability, relational embeddedness and routines. The findings provide support that the inter-organizational exchange properties and their interdependencies influence the nature of the interactions between buyers and sellers concerning the use of Internet tools.

Explaining variations in the use of Internet tools

Communication and brokerage-like Internet tools were expected to provide a solution for the relatively high transaction costs of the recycling industry. However, the influence of the specific inter-organizational exchange properties vary across the three studied Internet tools. The findings indicate several limitations of the antecedents of TCT to explain and predict the use and effects of Internet tools. Examples are the skeptical views of wholesalers with regards to the supposedly efficient Web-based auctions, and the large use and experienced benefits of email, indicates certain limitations.

Below we discuss the findings concerning the influence of inter-organizational exchange properties on the variations in the use and effects of Internet tools.

5.1.1. Transaction attributes

Price uncertainty and real-time data feed services

The high popularity of the use of real-time data feed services can be explained from the ongoing need for more detailed, faster and greater access to price information. Findings provide support that these services reduce the costs of price determination in exchange associated with the transaction attribute price uncertainty.

Product specificity and real-time data feed services

The interviews did not provide evidence that product specificity influenced the use of real-time data feed services. One of the reasons for the lack of influence of product specificity on the use of real-time data feed services is the relative heterogeneity of nonferrous scrap metals. Although prices of exchanges and polling data provide an indication of its value, the specific premium is often negotiated by the seller and the buyer. As a wholesaler indicated:

“If the market has a movement up or down usually everybody within the industry knows what that movement is. ...So, it’s not like it’s a well kept secret. Everybody talks to everybody and everybody knows what the movement in the market is. So, say for instance last month you sold material at \$200 a ton, this month the market moved down 25, it’ll be worth 175. Then again if that individual needed more he might pay 180, a \$5 premium to get more” “Each situation has different [issues], there are no set rules” (Interview I-1 .

Frequency and real-time data feed services

The study found no indications that recyclable material wholesalers use real-time data feed services to reduce problems with materials they sell infrequently. It was expected that real-time data feed services would reduce coordination costs associated with infrequent transactions. For example, the use of online price data services could provide sellers with up-to-date price information about recyclable materials which they may sell infrequently. One of the explanations for a lack of influence of the frequency of transactions on the use of real-time data feed services may be that wholesalers use real-time data feed services concerning scrap materials forming their main business. It is just an incidental circumstance for recyclable material wholesalers if other scrap metals are covered by real-time data feed services that they may infrequently sell. In addition, materials that are infrequently sold by wholesalers may also have a low volume of sales within the scrap metal industry. This lack of volume provides no incentives for real-time data feed services to cover these specialized materials.

Product specificity and email

The lack of influence of product specificity on email use contradicts Proposition 1b. There were only some indications that recyclable material wholesalers did exchange digital pictures via email which enabled buyers to assess the quality and their ability to use the material. The lack of consistent findings also indicates that a reduction of transaction costs associated with product specificity is more related to production technologies enabling flexible production than to the use of Internet tools in inter-organizational exchange.

Price uncertainty and email

Email provides localized digitalization of certain activities, in this way reducing both coordination and safeguarding costs. For example, email enables faster communication and interactions between buyers and sellers and also provides access to real-time data feed services.

Infrequent exchanges and email

Infrequent exchanges do not contribute to the establishment of trust and inter-organizational routines which enable sellers to better understand the needs of specific buyers (Choudhury et al., 1998). A lack of routines makes it necessary to discuss every aspect of the transaction in detail. The use of email enables the exchange of translated documents. It was not really clear whether translated documents were used to reduce transaction costs associated with infrequent transactions. The reason being that routines are less developed with infrequent buyers, and email may increase and enhance communication and thus reducing coordination and safeguarding costs. Safeguarding costs were not included in the original Proposition 1c. Based on the findings, this proposition on the effects of infrequent transactions on the use of email and transaction costs should be modified to include both coordination costs as well as safeguarding costs.

Price uncertainty and Web-based auctions

The findings of the confirmatory case studies indicate that Web-based auctions are used by a few firms who experienced a reduction of coordination costs. From the findings it is revealed that Web-based auctions introduce automated price discovery mechanisms,

which allow an efficient processing and selection of bids from potential buyers. The findings indicate that sellers of non-ferrous metal scrap using the auction experience lower coordination costs as a result.

Web-based auctions: Product specificity and buyers from low labor cost countries

One of the interesting findings is that low-grade scrap materials are sold at the auction. It may have something to do with the fact that high-grade recyclable materials are more in demand by (existing) customers than low-grade materials, due to the reduced risk for the buyer (e.g., less contaminations). The connectivity offered by auctions influences the ability to contact buyers outside a regional market. The incentives to use Web-based auctions to provide greater opportunities to connect with more buyers increase the number of potential sellers, and the ability of auctions to reduce search costs and price discovery costs. At the same time, the automatic processing of bids enable the seller to maintain a high level of competition between buyers. Non-ferrous metal scrap has a relatively high value-to-weight ratio, making it fiscally suitable for export. The auction enables sellers to access buyers who can process semi-processed scrap relatively cheaply due to low labor costs. These materials have a relatively high product specificity within the US market, since special machines are needed for processing. However, manual labor, which is in abundant supply in the buyers' countries of origin, reduces product specificity. Low grades of scrap fulfill market needs in developing countries of which there is a greater demand for lower quality metals (Goodrich, 2000).

Web-based auctions: Relatively infrequency and routines

It is shown that recyclable material wholesalers use the auction to sell materials which make up only a very small percentage of their total business. Such a low percentage indicates that wholesalers sell these materials somewhat infrequently on the spot market, which may have contributed to the use of Web-based auction services. It could be the case that buyer-seller routines may have not been as established as would be the case with materials sold at a relatively high frequency (Choudhury et al., 1998). Also, the seller would have less knowledge about the ongoing prices and demand situation. The use of a Web-based auction could improve his/her relative bargaining position, since the auction automatically process bids and enable the seller to find the highest bidder.

Non-use of Web-based auctions: Price uncertainty vs. other aspects exchange

The heterogeneous nature and content of recyclable materials is one of the reasons that the recycling industry lacks a formal commodity exchange. Businesses contact each other directly through an informal mechanism of concurrent bilateral negotiations. Open-bid auctions introduce the automated processing of bids and anonymous selection of the highest bidder. As a result, exchange is reduced to solely a discovery of prices. However, auctions use prices as the main allocation mechanisms, whereas wholesalers argue that exchange is much more than price alone. There are other equally-important aspects of trade of recyclable materials, such as the specifications of materials, way of loading, payment options, services/customization and checking the financial standing of the buyer. Negotiations offer the seller the flexibility to select the best offer and buyer, based on

price quotes, long-term prospects and continuation of valued business relationships, among other things.

5.1.2. Internet capabilities

Internet capabilities and real-time data feed services

Greater price transparency regarding prices in adjoining, national and global markets gives recyclable material wholesalers more leverage with the consumers and other wholesalers who buy their processed or semi-processed recyclable materials. However, arbitrage occurring on the future exchanges reduce price differences between exchanges and countries, making it harder for wholesalers to get an above normal price. Further, connectivity capabilities provided incentives for wholesaler to use real-time data feed services because it provided access to hedging capabilities. Sellers increasingly perform hedging activities in the primary markets for metals, to secure the profit margins of ongoing transactions. This issue of connectivity capabilities provided by real-time data feed services is further discussed in paragraph 5.4.1 on the structuration of the use of real-time data feed services.

Connectivity and email use

The ability to connect to new and existing buyers contributed to the use of email as further discussed in paragraph 5.4.2 on the structuration of email use.

Digital representation of products and email

In addition, wholesalers use email in the exchange of digital images and translated documents, to enable communications that are more comprehensive and detailed. For example, wholesalers/processors exchange digital images with buyers to resolve issues

concerning the content and quality of materials, the way materials are loaded into a container, etc. Emailing digital pictures enables fast and meaningful interactions, reducing the likelihood that superfluous concerns/problems get out of hand, disrupt transactions and jeopardize relationships. Email also helps reduce safeguarding costs, or rather prevents them from occurring.

Connectivity capabilities of Web-based auctions

A broker may reduce the costs for the seller if employed, but brokers do that only in return for a fee to sell the materials. A fee which may reduce the profit margin for the seller significantly. Processors perceive the insertion of ‘the auction’ as eating from increasingly slimmer margins which are already under pressure due to an increasingly competitive market (Interviews). Wholesalers also perceived the Web-based auction as the insertion of another layer of intermediaries within the value chain. They regarded the auction as ‘just a broker’, indicating that the Web-based auctions is really just old wine in new bottles.

Digital representation and Web-based auctions

The findings show that direct communication between buyers and sellers at the auction is valued by recyclable material wholesalers, since it enables market actors to exchange digital pictures of scrap materials by email. It is interesting to see that the use of email compliments the use of Web-based auctions.

Non-use of auctions: Connectivity

The increase in potential buyers reached through a Web-based auction should not be overestimated, since recyclable materials wholesalers are contacted by new potential buyers outside the auction setting on a daily basis. However, wholesalers indicated that the suitability and relevance of these types of offers from unknown parties are often regarded as questionable or irrelevant. This perception might have carried over to the perception of the auction as an Internet tool unfit for use.

5.1.3. Relational embeddedness

Relational embeddedness and real-time data feed services

Relational mechanisms such as trust only marginally influence the use of real-time data feed services. However, online price services do in most cases not negatively influence relationships. Rather, it can be argued that wholesalers are more likely to converge towards similar price expectations referred to as a fair price. As a result, buyers and sellers may strengthen relationships and reduce coordination and safeguarding costs. A wholesaler discussed the idea of a fair price in the following way:

“The market price, if you think about, may not always be a fair price. We’ve had times where certain grades are worth, there’s a seven cent differential between prime [nonferrous metal] and a scrap item and then I’ve seen it where the same item is a twenty cent differential. So, what’s a fair price?” (Interview L-1).

Relationships and email

Email does not lead directly to changes to the way wholesalers do business, such as by performing concurrent bilateral negotiations or trade with trust business partners. Rather, email keeps relationships intact and may strengthen (in particular international) relationships and business contacts. It is also observed that Internet tools can help build relationships (Pauleen & Yoong, 2001). Email is a generally-accepted tool which helps wholesalers do more in less time, reducing communication costs and speeding up interactions.

Relationships and Web-based auctions

In many industries, B2B trade is facilitated by business relationships. Some brokerage-like Internet tools seem to threaten these valued business relations and will therefore trigger skepticism and discourage market actors from their use. Web-based auctions created controversy among market actors because of perceived potential to disrupt and destroy relationships explaining for a great part the observed low use of Web-based auctions within many different industries. Firms are not willing to risk market share and important company assets such as relationships. Auctions are still regarded by market actors as an unproven technology, which tend to jeopardize the most valuable asset and capability within the recycling industry, namely relationships and business contacts. Therefore, the opportunities of the growth of Web-based auctions might be limited in other industries as well, due to the potential negative effect on the way firms do business.

Non-use of Web-based auctions: Relationships

Negotiations enable to explore and customize the specifics of a transaction, which may be preferable with a greater degree of product heterogeneity (Bichler et al., 2002). Business relationships provide a mechanism in which the market participants are more comfortable about negotiating the specifics of a transaction which are not fixed before engaging into an exchange. Auctions tend to jeopardize, threaten and even destroy existing relationships, the same relationships which help wholesalers to reduce both coordination and safeguarding costs in the first place. For example, an auction seller cannot determine the eventual buyer in a public open-bid auction before or after the onset of the auction

sale. Unanimous bidders increase the uncertainty among sellers about buyer's identity and behavior.

Non-use of Web-based auctions: Quality issues and joint problems solving

Sellers also expect more problems with buyers concerning the determination of quality, content and composition of materials. Consider a buyer who bought semi-processed non-ferrous scrap materials at the auction. However, after handling the materials the buyer concluded that the content of non-ferrous metals differed about one percent with what was described at the auction sale. This difference may be part of a normal business risk. For example, it is relatively difficult to estimate the exact content of non-ferrous concentrates sold at the studied Web-based auction, due to material characteristics such as loose wires and cables, electrical motors and ZORBA. Negotiations would have enabled the buyer and seller to discuss a possible downgrade. However, in this case, the buyer was advised to adjust his auction bids accordingly to the percentage of materials he experienced, which he did on later occasions. Although reputation systems would potentially reduce these types of problems, we should not expect too much from technological solutions. For example, it is observed that these reputation systems are not often used by auction sellers and buyers (Dholakia, 2005).

5.1.4. Joint planning and demand variability

Joint planning and real-time data feed services

Real-time data feed services makes joint planning more efficient and effective since contract prices may be tied in with an industry price index, functioning as an 'objective' measure.

Joint planning and email

Email is reinvented to equip firms with brokerage-like capabilities, such as email broadcasts, which can reduce transaction costs without jeopardizing relationships and the way of doing business.

Joint planning and Web-based auctions

The findings show that Web-based auctions are suitable to engage in joint planning since buyers are not known until the end of the auction. Also, buyers may differ in each auction sale, which makes it again harder to establish a relationship with buyers. Relationships provide the trust to engage in joint planning. In effect, joint planning is not influencing the use of auction sellers.

Non-use of Web-based auctions: Supply variability and joint planning

Unanimous buyers may not be committed to buy materials from the seller in the future, when market prices are changing. Relationships fostered through negotiations enable sellers with greater opportunities to plan production, trade and the possibility of

customizing the recyclable materials according to the specifications of the buyer. Web-based auctions endanger the valued relationships of wholesalers. Firms often prefer to develop long-term contracts since it provides market actors with more stability in the demand and supply for recyclable materials (Interviews). Other industries also experienced that relationships are crucial to reduce transaction costs associated with the vulnerability to demand and supply disruptions (availability) such as the recycling industry (Morrison & Waters, 2005).

5.1.5. Inter-organizational routines

Existing routines promote the use of real-time data feed services

The real-time data feed services originate from and greatly resemble traditional price services, such as price lists distributed on paper and by standard mail. The main difference is that the new services update information on prices and news constantly and instantly, instead of through daily, weekly or bi-weekly updates. The great resemblance and almost perfect substitution of these services promotes use. The advantage being that recyclers do not have to directly implement any significant adjustment to their business processes and trading routines in order to use the new online services. Wholesalers are therefore already accustomed to the use of price services.

Real-time data feed services and strong effect on coordination costs

Real-time data feed services can be regarded as a communication-like Internet tool with capabilities to increase access to price and market data. Real-time data feed services are frequently used among many market actors, since they provide them with an instrument to improve the evaluation of bids (price quotes) and contribute to the minimization of asking prices. Real-time data feed services support ongoing negotiations, trade activities and transactions for sellers, since the expectations of buyers and sellers concerning prices are much more accurately based upon market prices (Interview L). Increased awareness and tracking of prices reduce coordination costs concerning price discovery, negotiations and contracting.

Business routines and email

Email accomplishes a great match/fit with the way firms do business, and increases the efficiency and effectiveness of trade activities, while allowing for incremental changes of business routines. The use of email does not seem to disrupt the way of doing business and does not jeopardize existing relationships⁵³. Email can lead to localized digitization, which may change business routines, for example, wholesalers may email buyers digital pictures instead of sending a test load. Email is viewed as an easy-to-use and handy tool which fits and matches business routines. Altogether, email makes inter-organizational exchange more efficient and effective.

Auctions and inter-organizational routines

One auction seller noted that a change of inter-organizational routine, namely closing off other market channels, contributed to his use of the auction. However, other sellers point out that the auction is only used for a very small product market. For most of the materials they sell, the Web-based auction is not the way they do business.

Non-use of Web-based auctions: Selling and buying routines and strategies

Buyer and seller routines for auction participation differ in how a sale is awarded (being sold to the highest bidder), when compared to conventional negotiations. However, auctions increase the risks and vulnerabilities related to the behavior of the unknown

⁵³ Of course, the content of email messages (not its use per se) may disrupt relationships e.g., when including offensive wording or pictures.

buyer and/or seller. For example, a wholesaler who did not place the winning bid for semi-processed materials had negative experiences with the way the auction sale was finally allocated after the final bid through negotiations. As a result, the wholesaler stopped using the auction, due to the lack of mechanisms to protect auction participants against the emergence of such new vulnerabilities.

In bilateral negotiations, processors have implemented, for example, costly business routines (e.g., specific instruments to check the financial standing of a buyer) and entered in trusted business relationships, to deal with the complexities of exchange, reduce uncertainties and safeguard their transactions (e.g., through components of an embedded relationships such as trust, reputation and reciprocity) (Interviews). Web-based auctions focus on price as the allocation mechanism and this fundamentally changes the way of doing business, such as by reducing the importance of business relationships and existing trading routines. As a result, these routines and business relationships become less valuable and useful for a wholesaler selling at the auction.

Non-use of Web-based auctions: Interdependencies and matching

The observations indicate a lack of a match between Web-based auctions and inter-organizational exchange properties such as business routines and existing relationships. The perceived lack of match/fit resulted in high skepticism whose subsequent result was the relatively low use of Web-based auctions among recyclable material wholesalers. The negative perceptions of Web-based auctions as a tool which fundamentally changes the way of doing business may well have been fueled by advertisement “slogans”, in addition

to comments of Internet tools entrepreneurs, investors and scholars in the late 90s that "Internet tools will change everything",⁵⁴.

Overview

Below an overview is provided of the findings (Table 12).

Real-time data feed services. Online real-time price services are widely used within the recycling industry. The findings show that the inter-organizational exchange properties formed by price uncertainty, Internet connectivity, joint planning and inter-organizational routines contribute to this high use.

Email use. Email is widely used within the recycling industry. The findings show that the inter-organizational exchange properties formed by price uncertainty, Internet capabilities (connectivity) and digital representation of products, relational embeddedness, joint planning and inter-organizational routines are all factors contributing to this high usage.

Niche markets served by the Web-based auction. In contrast, Web-based auctions are used by only a small number of recyclable material wholesalers. The inter-organizational exchange properties formed by transaction attributes (price uncertainty and product specificity) and Internet capabilities (connectivity) contribute to the use of Web-based auctions. Findings indicate that the web-based

⁵⁴ Quote refers to Cisco's company slogan used in advertisements

auction seem to be successful in certain niche markets and generates satisfactory results among sellers. Success beyond the specific niche markets is still limited. All inter-organizational exchange properties contribute to non-use, although relational embeddedness, joint planning and inter-organizational routines in particular are the most important drivers for use.

Table 12: Inter-organizational exchange properties and Internet use

Inter-org. exchange properties	Indicators	Real-time data feed services	Email	Web-based auction	Non-use Web auction
Transaction attributes	Price uncertainty	+++	++	+++	--
	Product specificity			+++	---
	Frequency		+	+	
Internet capabilities	Connectivity	++	++	+++	-
	Digital representation		+++	++	
Relational embeddedness	Trust	+	+	-	---
	Information sharing	+	+	+	---
	Joint-problem solving	-	+++	---	---
Demand variability / joint planning		++	++	--	---
Inter- organizational routines	Routines (narrow sense)	+++	+++	-	---
	Rules of thumb	+++	+++	--	---
	Strategies	++	+	+	---

Notes:

- a) + refers to a positive effect; - refers to a negative effect;
- b) The number of plusses or minuses indicates the strength of the observed relationships.

In the next section, we will discuss the effects of the use of real-time data feed services, email, and the Web-based auction on coordination and safeguarding costs.

5.2. *Effects*

The findings indicate that recyclable material wholesalers reap the benefits from the use of so-called “simple”⁵⁵ Internet tools, such as email and real-time data feed services when selling their processed materials. However, only a small number of wholesalers use auctions, while most are highly skeptical of the benefits of “sophisticated” Web-based auctions. This is due, in part, to the fact that wholesalers experienced and foresaw a rise in safeguarding costs. The observed large use of communication-like Internet tools (email) and its effects on transaction costs, in addition to the relatively low use of brokerage-like tools (online auctions and supply/demand aggregators) is supported by other studies (Humphrey et al., 2003; Pare, 2003). The effects of Internet tools on transaction costs and relationships are summarized in the Tables 13, 14 and 15.

Real-time data feed services reduce coordination costs

The use of real-time data feed services provides recyclable material wholesalers with up-to-date price information, in effect reducing negotiation and contracting costs.

⁵⁵ Statements such as “simple” or “conventional” are more or less value judgment, since there is a lack of objective criteria to rate applications on a scale of “sophistication”.

Email reduces coordination and safeguarding costs

Email is widely used within the recycling industry by recyclable material wholesalers. The use of email for communications, exchange of digital pictures and email broadcasts reduces coordination and safeguarding costs.

Auctions reduce coordination costs but increase safeguarding costs

The relatively low use of the auction is in contrast with early theoretical predictions derived from TCT being applied to electronic markets. Theoretical assumptions would make us expect that the recycling business possesses the correct conditions for the use of Web-based auctions, and that they would lead to a reduction in coordination costs, in comparison to, for example, negotiations. However, the reduction of coordination costs by Web-based auctions is accomplished by a fundamental change of the conventional way wholesalers do business through concurrent bilateral negotiations. Findings indicate that these changes are the basis of the highly skeptical views and relatively low use of auctions displayed by wholesalers.

In addition, market actors perceived the option to renegotiate a sale after an unsuccessful auction as strategic behavior and in conflict with the way firms do business. This is in contrast with the earlier reported experiences of auction users and the auctioneer. For example, authors focused predominantly on the costs of renegotiations, but not on the perception of strategic dishonest and unfair behavior and the effects on e.g., reputation of the seller and the auction as an institution (Jap, 2002; Wang, 2000).

Table 13: Effects of Internet tools on coordination costs

Use of Internet tool	Effects on coordination costs	Examples
<i>Real-time data feed services</i>	--- Reduction	Continued price updates reduce uncertainty about prices during negotiations
<i>Email</i>	-- Reduction	Exchange of digital images of materials
<i>Web-based auctions</i>	--- Reduction	Automated processing bids, and selection of buyer
<i>Non-users of Web-based auctions</i>	+ Increase	Unable to customize materials

Note: The number of plusses or minuses indicates the strength of the discussed phenomena.

Source: Explanatory interviews Appendix A, B, and C.

Table 14: Effects of Internet tools on safeguarding costs

Use of Internet tool	Effects on safeguarding costs	Examples
<i>Real-time data feed services</i>	- Reduction	Hedging, but may be too costly in comparison to a specific transaction
<i>Email</i>	-- Reduction	Pictures of container load
<i>Web-based auctions</i>	+ Increase	Increased vulnerability to price shocks, and downgrades
<i>Non-users of auctions</i>	+++ Increase	Increased rejections and downgrades due to inability to solve problems jointly

Note: The number of plusses or minuses indicates the strength of the discussed phenomena

Source: Explanatory interviews Appendix A, B, and C.

Table 15: Effects of the use of Internet tools on transaction costs

Internet tools	Coordination costs	Safeguarding costs
<i>Real-time data feed services</i>	---	not enough data
<i>Email</i>	--	---
<i>Web-based auctions</i>	---	+
<i>Non-users of auctions</i>	+	+++

5.2.1. Interdependencies

The recycling industry is confronted with high transaction costs due to the heterogeneous nature of the materials (e.g., quality and composition) and demand uncertainty, among others. Negotiations are the preferred price discovery mechanism to conduct trade. There are indications that the use of negotiations has led to the emergence, co-development and interdependency of other inter-organizational exchange properties, such as relationships and routines. Wholesalers have perfected the use of negotiations and associated interdependencies (e.g., relationships) to conduct trade within the industry value chain segment (namely exchanges between processors and consumers). The co-evolution of inter-organizational exchange properties enabled and enhanced the facilitation of the trade of recyclable materials by reducing coordination and safeguarding costs. Transaction costs are thus influenced by specific interdependencies between inter-organizational properties. Negotiations, relationships, routines, as well as their interdependencies are therefore the lubricant and facilitators of B2B exchange, and are a part of the way people do business. Market actors may accordingly develop a “preference” for the way of doing business, which is associated with and tied into specific interdependencies, such as between negotiations (thus price discovery mechanism) and business relationships, since this provides a way to reduce transaction costs.

Observations show that Internet tools affect relationships and routines differently, because some Internet tools (e.g., Web-based auctions) imply a new price discovery mechanism, whereas the use of real-time data feed services and email do not. The introduction of a new price discovery mechanism (e.g., Web-based auctions) seems to

lead to changes or rather the "collapse" of existing interdependencies between negotiations, relationships and routines, and their combined or complementary effect on transaction costs. For example, the findings show a negative effect of routines and relationships on the use of auctions (Table 12).

Interdependencies between negotiations and business relations can drive down transaction costs and create opportunities to differentiate products through customization. This is because relationships between buyers and sellers over time bring components of an embedded relationships into play such as trust and joint problem solving, which speed up negotiations and interactions, facilitate exchange and reduce potential problems. Business relationships thus help wholesalers reduce market uncertainty and the cost of a transaction. The findings also indicate that the interdependencies between negotiations and routines drive down coordination and safeguarding costs. Business routines are shared among organizations and within the industry value segment. These routines set particular expectations, which result in more efficient and effective performance of trade activities. For example, routines enable sellers to quickly solicit and compare quotes. Familiarity between buyers and sellers makes it easier to assess the quality of materials and improve the deal's prospects. Also, sellers use specific routines to address buyer's complaints or concerns, such as suggesting and handling downgrades.

The technological capabilities (e.g., communication and brokerage) of the tool "interface" and interact with one or multiple inter-organizational exchange properties, in addition to their interdependencies. Variations in the use and effects of Internet tools can be traced

back to the effect of each tool on these interdependencies. The way Internet tools affect these interdependencies influences the ability of wholesalers to use the tool to reduce coordination and/or safeguarding costs. For example, the findings show that auctions dislodge relationships and routines. Therefore, auctions sellers experience and non-users perceive an increase in safeguarding costs, which reduces the use of the auction beyond the specific market niche.

Wholesalers seem to perform a conceptual match between the capabilities of the Internet tools and the existing ways of doing business. Wholesalers understand that the communication and brokerage capabilities of Internet tools may affect coordination and safeguarding costs negatively or positively, and may require fundamental or incremental changes of the used price discovery mechanism (Table 16). For example, email enables the exchange of digital images, which enable a quick assessment of the quality of the materials, and may reduce potential after-sales problems with buyers. Auctions reduce price discovery costs, but jeopardize relationships and routines which lead to (perceived and experienced) an increase of safeguarding costs. Differences in the degree of the match or fit between the capabilities of Internet tools and inter-organizational exchange properties (e.g., effects on industry-wide accepted price discovery mechanisms such as negotiations) lead to variations in the use and effects of these tools.

Table 16: Effects of the use of Internet tools on price discovery mechanism

Use of Internet tool	Effects tool on price discovery mechanism
<i>Real-time data feed services</i>	Small incremental changes
<i>Email</i>	Small incremental changes
<i>Web-based auctions</i>	Fundamental changes

5.3. *Support for conceptual framework*

Studies on the industry level are rare, with industry-wide studies of Internet use being even more so (Feldman & Pentland, 2003; Pinker et al., 2003). The developed framework fills a gap in industry-level studies and analysis of the use of Internet tools applications, by specifying the antecedents (inter-organizational exchange routines and interdependencies), as well as explaining the variations in use and effects. The framework provides an explanation of the observed variations in the use and effects of Internet tools, previously thought of as: measurement errors or problems, exceptions or rather imperfections of a theoretical idealist concept of the market or friction due to components of an embedded relationships, processes and context. Observations with regard to the influence of the inter-organizational exchange properties on the variation in the use of real-time data feed services, email, and Web-based auctions provide confidence to support the conceptual framework.

The findings of the confirmatory case studies provide support for the propositions that inter-organizational properties and their interdependencies influence the use of communication and brokerage-like Internet tools and their effect upon transaction costs. The findings provide multiple indications of how the inter-organizational exchange properties and their interdependencies help explain why communication-like tools such as real-time data feed services and email reduce both coordination and safeguarding costs. The reason is that almost all the inter-organizational exchange properties have led to the

high use of email and real-time data feed services (Table 12). However, brokerage-like tools such as Web-based auctions reduce coordination, but tend to increase safeguarding costs. The conflict between the newly introduced price discovery mechanism of brokerage tools and the inter-organizational exchange properties relational embeddedness and routines explains the low use of Web-based auctions. This provides us with more confidence to support the conceptual framework as providing an explanation for the observed variations in the use and effects of Internet tools.

5.3.1. Underestimation and overestimation

Variations in the use and effects of Internet tools are not well predicted by theoretical propositions based on TCT alone. The case study findings provide indications that TCT tends to simplify the antecedents of the industry-wide use of Internet tools towards transaction attributes. Studies grounded in transaction cost theory underestimated the fact that Web-based auctions imply a radical new price discovery mechanism, whereas the use of real-time data feed services and email complement existing negotiations, business relationships and routines. As a result, studies grounded in transaction cost theory may have overestimated the industry-wide use and effects of brokerage-like tools, and underestimated the industry-wide use and effects of communication-like tools.

The specification of the antecedents of the use of Internet-based tools enabled the identification of the manner in which inter-organizational exchange properties interface with the communication and brokerage capabilities of Internet tools. For example, wholesalers “select” and use those brokerage or communication-like Internet tools that

enhance or do not disturb interdependencies between inter-organizational exchange properties and price discovery mechanisms. As a result, the use of those ‘matching’ Internet tools enables market actors to reduce both coordination and safeguarding costs. These interdependencies explain the variations in the use and effects of Internet tools within an industry value segment.

This study provides an increased the understanding of the incentives of the use of specific Internet tools and the potential benefits their use generates beyond TCT. To view the use and impact of Internet tools beyond the use of a single application reduces the likelihood of potentially misleading and unjustified generalizations and incorrect extrapolation about their role, their benefits and the growth of individual Internet tools.

5.4. *Emergent findings*

The findings indicate further that the use and the structuration of the use of Internet tools are influenced by the match between the communication and brokerage-like capabilities of Internet tools, inter-organizational exchange properties and industry-wide social norms and values.

5.4.1. Structuration of use in real-time data feed services

Greater access to market prices of primary metals may also coincide with an increased demand for advanced financial instruments, thus enabling market actors to hedge their transactions. Hedging may help offset rising material costs and protect against price fluctuations, as observed in many other industries (e.g., Southwest was able to turn a profit because it had hedged the costs of jet fuel). Real-time data feed services almost perfectly match the way people do business, and are in accordance with industry-wide and accepted social norms and values. For example, it is perfectly legitimate to refer to the prices established at commodity exchanges such as the London Metal Exchange (LME) during negotiations.

Real-time data feed services provide information about unbiased primary commodity markets (e.g., open-trading pit at the LME), additionally enabling hedging activities/strategies in primary commodity markets by buyers and sellers of recyclable materials. It seems that online price information tools are therefore used as a brokerage-like tool to hedge transactions in primary markets. Hedging in primary markets acts as a

surrogate of brokered e-markets for recyclable materials. As a result, wholesalers are able to reduce safeguarding costs. Real-time data feed services match almost perfectly with conventional price services which were distributed physically on paper (e.g., by trade newspapers and bulletins). It took only a small change to introduce the digitized version of price services, only making it faster, more detailed and more accessible.

5.4.2. Structuration of email use: Underestimated and misunderstood

Email is often regarded as a low-tech Internet tool. At the same time it is one of the most-used Internet tool in the trade of recyclable materials. Email enables the localized digitization of existing trade activities, such as exchanging documents and other communications. Furthermore, we observed that email is adjusted to fit the existing ways of doing business such as business relationships and trading routines. By doing so, email enables wholesalers/processors to introduce small and very subtle improvements, which reduce both coordination and safeguarding costs (e.g., sending pictures instead of test load). The introduction of new adaptations of the use of Internet tools has been previously identified as reinvention (Johnson & Rice, 1984). In this study, we observed reinvention or rather structuration of the use in the type of email, real-time data feed services and auction use, but did not have the opportunity to observe any changes in the specific code of the computer programs themselves.

The perceived match/fit of email with existing ways of doing business has provided the capacity for wholesalers/processors to experiment with small changes that have since gained industry-wide acceptance. The incremental changes have led to the emergence of new trading routines, such as exchanging digital pictures, email broadcasts, receiving price information and wireless email. These new routines have gained increased acceptance within the industry, although they change existing routines and make some less-used or even obsolete. Wholesalers/processors often state that they can do business without email, “but its (email) use just makes things more efficient and enables them to work more effectively” (Interviews).

Email and brokerage-like capabilities

Email has been able to adapt to its communication capabilities and the structuration of the use of Internet tools enabled the introduction of brokerage-like capabilities which meet the needs of wholesaler. Email is currently so much more than a simple tool to exchange text messages. Its flexible character and easy incorporation into existing ways of doing business (match/fit) has fueled the uptake in its use, as well as encouraged experimentations and eventually the structuration of the use of Internet tools. For example, exchanged digital pictures are now being stored by market actors to increase understanding of the types of materials available in the marketplace (Interview). Also, email broadcasts have brokerage-like capabilities, since buyers use them to distribute calls for proposals.

The structuration of the use of email changes of the ways of doing business

The observations of the way email is used indicate that firms try to optimize existing routines and introduce new ones to increase the efficiency and effectiveness of trade activities. An ongoing adjustment of routines through email use helps wholesalers/processors increase the match/fit of email capabilities within the market environment, as well as emerging business opportunities. Incremental changes are easily adopted since they match/fit with the way firms do business and have a direct effect, such as improved effectiveness of communications and increased sales agent productivity (Interviews). Structuration of use enables a different use of email which enables wholesalers to reengineer business processes. Earlier research showed that routines can indeed be sources of stability, inertia and change (Feldman & Pentland, 2003).

Industry-wide norms and values

Email use has led to incremental changes, which are accomplished through simple and easy digitization of activities which fit easily within existing trading routines and activities. However, such incremental changes can cause a trickledown effect, which may affect market structure and competitive dynamics at a later date (Porter, 1985, 2001). We observed changes in the use of email that led to the emergence of new trading routines (e.g., emailing digital images) and selling strategies (broadcast emails). This structuration of the use of email resulted in the reduction of the relevance of conventional routines.

Localized digitization and changes of activities have led to changes of existing routines or series of routines. At the same time wholesalers are comfortable with adapting to

changes, as well as incorporating and accepting the new routines (e.g., exchange of digital images). The structuration of the use of email and subsequent benefits are recognized and accepted on an industry-wide level. What is remarkable is that these changes do not stir any reaction or resistance among market actors. One of the reasons this is true might be that the changes in use match with the norms and values which guide the way firms do business. These social norms and values are sometimes referred to as “macro-culture” or the “institutional field” (Abrahamson & Fombrun, 1992, 1994; DiMaggio & Powell, 1983).

5.4.3. Structuration of the use of Web-based auctions

The structuration of technology use is also observed in the way auctions are used in several other instances. The studied auction tries to build a respectful business and has been able to get firms to subscribe who then conduct business over this Internet tool. However, many market actors “are hesitant to do business outside of their normal circle of trading partners” (SEFEX, 2004), due to concerns about quality, financial standing and honest behavior, among others. First, the auctioneer implemented and changed auction features in an attempt to adapt it in such a way so it does not interrupt or, even more desirable, actually enhances existing ways of doing business, while respecting existing norms and values. For example, the auctioneer enabled direct communication between buyers and sellers prior to the start of the bidding process, so they are able to verify and discuss the material quality, conditions, terms of sales, etc. (Interviews). The findings indicated that direct communication reduced the uncertainty of the seller about the quality of the materials and the buyers’ ability to handle the materials.

Second, the auctioneer introduced the ability to hold different types of auctions, such as private auctions. Private auctions enable sellers to pre-select potential buyers, so the buyer with the successful bid is known in advance. This relieves the concerns of many sellers, since they know that buyer is capable of handling their materials, and that the buyer is reassured about the quality of the materials. Thus, an alignment with the current and accepted way of doing business drives the evolution of the features of Web-based

auctions. It should be noted that private auctions are still used less than open-bid auctions (Interviews).

Third, the auction changed ownership. Previously, the auction was owned by a couple of material processors. However, it was bought by a respected information systems management firm in the scrap metal industry. This change of ownership brought the auction more into alignment with industry-wide norms and values of fairness, integrity, and impartiality. It thus became an independent intermediary, one not involved in the actual trade conducted by market actors using Web-based auctions. The auction further secured the backing of an industry insider who knows the trade.

Industry-wide norms and values

Auctions also triggered incremental changes (e.g., selling strategies) which emerged from their use and the effects of user experimentations and the structuration of the use of Internet tools. For example, the introduction of a new selling strategy by a buyer only yielded results after considerable time. It took buyers a while to notice and incorporate the change and subsequently become comfortable with it. Buyers may have performed a conceptual match between the reinvented uses and the existing social norms and values, reassuring the buyers about the fairness of the strategy.

5.4.4. Social construction

Earlier we concluded that Internet tools vary in use according to differences in the degree of match or fit (conflict) between their capabilities and the existing way of doing business, such as one of a firm's most valued assets, this being their existing business relationships and contacts (Teece, Pisano, & Shuen, 1997). However, the observation of reinvented uses indicates that this matching process is more complex than previous thought.

The use of email and Web-based auctions differ in the way they match with existing inter-organizational exchange properties. The observations of the structuration of the use of the Internet tools indicate that the use of the three Internet tools is influenced by the match between inter-organizational properties, the (reinvented) brokerage and communication capabilities of Internet tools and industry-wide accepted norms and values (e.g., fairness, fair market price, honesty and integrity).

Users and non-users search for a match/fit with the brokerage and communication capabilities of Internet tools to the conventional way of doing business, as described by the inter-organizational exchange properties, as well as industry norms and values. A greater match/fit seems to reduce the resistance of market actors towards the use of specific Internet tools. However, match/fit may differ across different activities and their effect on coordination and safeguarding costs. The match should also not be regarded as static. For example, match/fit may strengthen or weaken over time depending on the emergence of reinvented types of usage, which may or may not be accepted by market

actors. The structuration of technology use occurs because users of Internet tools are able to change their behavior, invent new strategies, find new purposes of use and implement and develop new routines, to reduce existing coordination costs and vulnerabilities. Wholesalers use those tools which they find acceptable or which are not based on industry wide norms and values (e.g., those uses of actions that are considered fair and maintain integrity).

For example, the structuration of the use of email usage by wholesalers/processors indicates that small incremental changes are within the realm of existing social norms and values, and its use is sequentially integrated into, for example, industry-wide routines and relationships (e.g., sending digital images instead of a test load). Another example is the use of auctions (thus the introduction of a new price discovery mechanism) and the fact that its potential the structuration of technology uses do not often fit within the realm of existing norms and values, thus preventing its integration. For instance, there is an industry-wide perception among wholesalers in relation to the downsides of auctions. In some cases, experimental usage supported the common perceptions of unfair and improper behavior, and subsequently strengthened the idea that auctions are not able to deal with common business challenges. However, the reinvention and modification of the selling strategy of one wholesaler on the Web-based auction enabled incremental changes towards the way things are done. It took some time before this reinvention and modification of the selling strategy was communicated and recognized within the marketplace. Apparently, the change matched the existing industry-wide social norms and

values, since buyers accepted the reinvented strategy after a while, leading to results above the seller's expectations (Interview).

5.4.5. Communication and brokerage-like Internet tools

The structuration of the use of Internet-based tools can lead to the development of communication and brokerage capabilities which can reduce both coordination and safeguarding costs. For example, email broadcasts are used to broker transactions. Hedging capabilities through real-time data feed services are used to hedge within primary metal markets. Furthermore, auctions are used to communicate prices and information on 'who is hot'. The reinvented use of Internet tools can subsequently lead to a reduction in (e.g., email broadcasts) or increase of transaction costs (e.g., renegotiations after an auction sale)⁵⁶.

Underestimation communication effect

Findings indicate that the structuration of technology use resulted in the use of Web-based auctions for communication purposes. Therefore, earlier studies may have underestimated the communication effect. Findings also indicate that the structuration of the use of email and real-time data feed services led to the use of brokerage-like capabilities. Therefore, earlier studies may have underestimated the brokerage effect. As such there are indications that the focus of previous studies on brokerage-like Internet

⁵⁶ Studies have tried to assess the occurrences and effects on prices of post-auction private negotiations in other industries, such as real-estate auctions (Ong, 2004).

tools, and the neglect of communication-like Internet tools, may have led to an underestimation of the communication effect and an overestimation of the brokerage effect.

However, as we have shown, the structuration of the use of Internet tools enables market actors to introduce brokerage-like capabilities which were previously identified as communication-like Internet tools, and vice versa. However, we are of the opinion that the structuration of Internet tools is relatively focused on strengthening the "original" capabilities of Internet tools, instead of reinventing new capabilities.

Summary

The structuration of the use of the three Internet tools was partly enabled by their match with industry-wide social norms and values. The structuration of Internet tools is accepted or used by other wholesalers if they fit the industry-wide social norms, values and inter-organizational exchange properties (also referred to as the existing or conventional way of doing business). There are indications of the existence of mutual dependencies between communication and brokerage capabilities of Internet tools and industry-wide social norms and values. We therefore have indications that market actors socially construct the use of Internet tools on an industry-wide scale.

The findings indicate that the use of Internet tools should not be regarded as static. The structuration of use enables the tools to adapt and evolve over time. Social norms and values influence the uptake of the use and reinvented usages of communication and

brokerage-like capabilities. Internet capabilities makes things possible, but the social norms and values, together with the inter-organizational exchange properties, guide the selection of those types of usages which market actors find appropriate. Wholesalers reinvent the use of Internet tools. However, only some of them match the social norms and values and are subsequently anchored to the way firms do business. The structuration of technology use is incorporated after users have gained experience in judging their qualities and practical use. The structuration of technology use, such as reinventions and modifications may influence routines and relationships, which again enables new opportunities to profit from emerging communication or brokerage-like capabilities of Internet tools. The process in which use and subsequent reinventions and modifications of Internet tools are influenced by the way market actors match the inter-organizational exchange properties with social norms and values, as well as communication and brokerage capabilities of Internet tools, has been referred to as the social construction of technologies.

5.4.6. Speculations on EMH and evolutionary stages of e-markets

Our interpretation of the findings enables us to speculate how communication and brokerage capabilities may form an indication of EMH and evolutionary stages. Malone *et al* suggested that unbiased e-markets were the result of the brokerage effect. It is for this reason that many researchers may have been directed to study sophisticated and complex brokerage-like Internet tools such as Web-based auctions and supply/demand aggregators. However, these studies have underestimated a move towards unbiased e-markets, by excluding email and online price information services in previous studies. As has been shown, email can be used as both a communication and brokerage tool, through induced technological developments and the structuration of the use of Internet tools.

Indication of the evolutionary stages depends strongly on the definition of biased and unbiased e-markets. For example, the introduction of a geographical dimension will influence the number of potential buyers or sellers. Therefore, biased and unbiased markets play a limited role on the global stage, which can be strengthened by the use of Internet tools. The definition is further complicated by the fact that Web-based auctions may also be biased (Granados et al., 2005). However, the finding remains that market actors are capable of reinventing the use of communication and brokerage-like capabilities of Internet tools. Thus, there are indications that the definitions of biased or unbiased e-markets are social constructions, rather than objective measures.

Potential pro-innovation bias

In hindsight, we can therefore conclude that the benefits of Internet tools were oversold by business consultants, trade press, and others. Propagators of Internet tools provided almost a utopian, utilitarian, and neo-classical view of economic activities and exchange, which sharply contrasted with pragmatic business approaches and hands-on experiences of firm managers.

These findings from the case studies support the earlier indications that the EMH did not work as expected. Although the recycling industry is confronted with relatively high transaction costs (e.g., high cost to discover prices), observations did not indicate a high use of brokerage-like tools. TCT, as applied to electronic markets, underestimated the negative effect of the use of brokerage-like Internet tools, and the associated skepticism of existing market actors (e.g., sellers). A possible explanation could be that studies of the antecedents, use and effects of Internet tools, may have had a pro-innovation bias (Rogers, 1995). Researchers emphasize the benefits of the use of brokerage-like Internet tools but fail to address the challenges, negative effects and the resulting resistance of market actors.

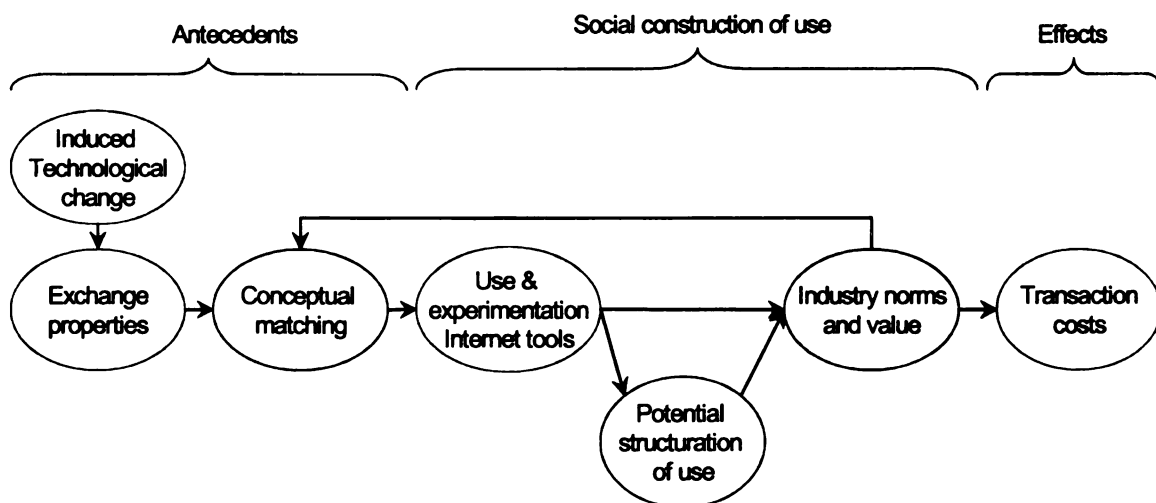
5.4.7. Further specification of framework and propositions

Based on the previous discussion it is possible to further specify the antecedents. The capabilities of Internet tools affect the interdependencies of the inter-organizational exchange properties. Internet tools are used which match (e.g., sustain or strengthen) the existing interdependencies. Induced technological change further enhances the communication and brokerage capabilities of Internet tools through the structuration of the use of Internet tools. For example, wholesalers reinvented the use of email by sending email attachments with digital images to buyers. Market actors may reinvent the use of specific tools so they gain communication and/or brokerage capabilities. The acceptance of the reinvented usage of Internet tools depends on the match between the reinvented capabilities, inter-organizational exchange properties and industry norms and values. Norms and values refer to how knowledge, experiences and expectations concerning the behavior of buyers, suppliers and competitors “shape the social structures (e.g., norms and values), and routines (e.g., habits, conventions and customs) in which traders transact” (Blois, 1999; Drumwright, 1994; Granovetter, 1985; Gulati, 1995; Hawkins & Verhoest, 2002; Houston & Johnson, 2000; Martinez & Dacin, 1999). The usages and reinvented use of Internet tools which are assimilated within existing industry-wide norms and values enable market actors to reduce transaction costs. This logic is presented in Figure 21.

The findings and analyses of the exploratory case studies enabled the revision of the framework which led to the following propositions, which should be tested in later studies (Yin, 1993):

1. The use of Internet tools depends on the match between the interdependencies of inter-organizational properties, the (reinvented) capabilities of Internet tools and industry-wide norms and values.
2. The structuration of the use of communication-like and brokerage-like Internet tools enables market actors to use any Internet tools for brokerage or communication.

Figure 21: Emergent framework



6. CONCLUSIONS

This chapter discusses the implications of the support for the framework for theory.

Second, the limitations of the study are discussed as well as a future research agenda.

6.1. *Support for framework and its implications*

This study started with a generic conceptual framework on the antecedents, use and effects of Internet tools. The framework was grounded in antecedents derived from and the rationale of transaction cost theory (TCT). This generic framework was the basis of many studies of Internet tools that predicted a reduction of transaction costs, and an evolution towards the use of brokerage-like Internet tools. However, observations derived from general secondary data sources (e.g., US Census Bureau) apparently contradict these predictions, due to a low use of brokerage-like Internet tools and a high use of communication-like Internet tools among businesses.

To increase the understanding of this contradiction, exploratory cases studies were performed in the recycling industry, an industry confronted with relatively high transaction costs. This was to study the effects of communication and brokerage-like Internet tools on transaction costs. A literature review and exploratory case studies within the recycling industry indicated the limitation of the theoretical assumptions provided by TCT (e.g., bounded rationality and opportunism), and provided a rationale augmenting the number of complementary assumptions. The augmentation of other assumptions

regarding human behavior (e.g., cooperation and evolutionary perspective) led to the identification of a more complete set of inter-organizational exchange properties affecting the use and effects of Internet tools.

The reported confirmatory case studies were performed to test this revised and augmented framework of the influence of inter-organizational properties on the use of Internet tools and their effects on transaction costs. The case studies supported the basis of the framework and enabled to understand variations in the use of Internet tools. For example, email use was high and reduced both coordination and safeguarding cost. The use of real-time data feed services was also high and also reduced coordination costs. Only a few firms used a Web-based auction which reduced coordination costs but also tend to increase safeguarding costs. The main reason why recyclable material wholesalers refrained from the use of Web-based auctions is that these tools imply a radical new price discovery mechanism. As a result, Web-based auctions tend to disrupt existing negotiations, business relationships and routines, whereas the use of real-time data feed services and email complements them.

Also, findings provided indications for a further specification of the antecedents, use and effects framework, through the introduction of the assumption regarding the social construction of technology and the structuration of technology use. As a result, a final framework is presented where a firm matches inter-organizational exchange properties with industry-wide norms and values, as well as the communication and brokerage-like capabilities of Internet tools. A high match will lead to high use and a low match will lead

to a relatively low use. Firms seem to reinvent the use of Internet tools to enable brokerage and communication. Furthermore, the structuration of technology use may or may not match existing interdependencies between the inter-organizational exchange properties and industry-wide norms and values. Recycling material wholesalers will use those reinvented Internet tools that complement the existing ways of doing business.

Implications of the synthesis of the three theoretical approaches

The support for the synthesis of the three diverse bodies of theoretical approaches, namely transaction cost theory, social embeddedness and evolutionary economics focusing on routines, provides an indication of the potential limitations of the original theories. The study findings suggest that the theories are linked through interdependencies between inter-organizational exchange properties. Collectively, the findings reported here provide insights into how each of these theories might be extended to accommodate such properties.

First, the cases illustrate how transaction costs theory has difficulty explicitly identifying and explaining the mechanisms through which coordination and safeguarding costs actually increase, when the Internet tools used do not match existing inter-organizational routines. Second, the findings indicate that the low use of Web-based auctions may not be based on a lack of buyers and sellers or lack of technological capabilities, but rather on the perceived disruptions of existing inter-organizational routines and business relationships. This implies that transaction cost theory has also difficulties to explain the incentives to use Internet tools that involve industry-wide inter-organizational routines

which are closely-linked with the price discovery mechanism used, instead of focusing on the individual firm and dyad.

Third, the findings suggest the limitations of taking an evolutionary economics focus on industry-wide inter-organizational routines, when attempting to understand the mechanisms through which the use of Internet tools are socially constructed. Evolutionary economics has difficulty clarifying the specific interdependencies between industry-wide inter-organizational routines and business relationships. The reason is that evolutionary economics tends to focus on the effects of the use of Internet tools on the individual routines of a firm, which only provides a limited explanation of the variations in the use of Internet tools.

The researcher acknowledges the fact that generalization of the findings to theory should take into consideration the specific contextual factors of the studied industry. Studies within other industries may identify variations in the type and strength of interdependencies.

6.2. *Limitations*

Exploratory and explanatory case studies have their limitations. A quantitative study would add to the validation of the findings. However, a survey would be impossible to perform since only a relatively small set of sellers are currently using the Web-based auction. Surveys were not feasible at the start of this study, since it would have increased the chance that the data gathered would be too superficial, due to the inability to thoroughly examine the research questions and propositions and follow up on emerging findings. The in-depth explanatory case studies are very well-suited to deal with the complexity of the topic and research method. However, wholesalers/processors still had some difficulties in explaining some of the inter-organizational exchange properties, the likes of business routines, business relationships and industry wide norms and values. One reason could be the fact that many trading routines, relationships and norms and values are not codified. The tacit nature of these inter-organizational exchange properties made it harder to study them. Also, case studies are limited in their ability to estimate the correlation coefficients between exchange properties, and to parameterize their effect on the use of Internet tools.

Furthermore, we have only a static view of the use and effects of Internet tools, since it was a cross-sectional study with similarly cross-sectional data. Some of the identified inter-organizational exchange properties and interdependencies develop over time. Thus, a one-shot study limits the possibility of fully understanding the evolutionary process, and how and why it changed over time. Surveys depending on the recall of the respondents

are limited. Therefore, longitudinal analyses might be needed to verify the findings and framework.

Recyclable material wholesalers process and trade (broker) materials. This may be an indication that there exist wholesalers who perform brokerage-like functions by themselves, which would affect their incentives regarding the use of auctions.

This study excluded all other effects besides transaction costs. However, Internet tools may also lead to more possibilities to differentiate products which may, for example, reduce production costs for consumers of scrap metals. Also, the effects on prices were also not studied. The collection of data on prices was limited, since wholesalers were very careful to talk about prices due to legal issues. Furthermore, not enough data could be gathered to explain the variation in the use of Internet tools between firms.

6.3. *Future research*

Future studies should perform a quantitative study of recyclable material wholesalers to test the revised framework. A survey would be able to parameterize the inter-organizational exchange properties, interdependencies between other exchange properties and the path coefficients between properties and the use and effects of specific Internet tools.

In addition, historical analyses are needed on the use of email in inter-organizational exchange, as well as its effect on transaction costs. For example, the "open-source" character of email reduces the need for a broker or auctioneer (besides an ISP), which may have favored the uptake in its use. Also studies should address how the increase of spam and subsequent security issues affect the use of email within transactions.

Other effects due to the use of Internet-based tools should be studied, such as differentiation activities by wholesalers and processors to add more value to a transaction. Such differentiation strategies might affect the production costs of consumers, since they have to do less to prepare scrap metals for their furnaces. Also needed is an in-depth study on the social construction of the use of Internet tools, with special attention paid to the role of norms and values. A time series might improve the understanding of role industry values and norms on the way firms match the (reinvented) use of communication and brokerage capabilities.

Also, the concurrent use of Internet tools, such as the difference in the way firms use tools within and between transactions, may indicate the influence of specific individual and relational routines. Last, little is known about the interdependencies between real-time data feed services and the industry-wide use of price discovery mechanisms. It would be interesting to study how real-time data feed services, providing derived prices from primary commodities, influence the need for and selection of a specific price discovery mechanism.

APPENDIX A: Explanatory case studies of scrap metal wholesalers

ID	Function	Phone Interview	Face-to-face Interview	Date	Company Website	User Web-based auction
A	Mgr. non-ferrous marketing		X	Sept '04	X	
B	Manager and trader		X	Sept '04	X	
C-1	Broker / trader	X	X	Dec '04		
C-2	Broker / trader		X	Sept '04	X	Formal user
C-3	Broker / trader		X	Sept '04		
D	Dir. non-ferrous marketing		X	Sept '04	X	X
E	Vice President		X	Sept '04	X	
F-1	Dir. non-ferrous marketing		X	Sept '04		
F-2	Vice President	X		April '04	X	
G	Vice President		X	Sept '04		
H	President	X	X	Sept, Nov, Dec '04		Formal user
I-1	Gen. Mgr. satellite yard	X		Dec '04	X	X
I-2	VP non-ferrous marketing	X		Sept '05		
J	Pres. & General Manager		X	Sept '04	X	Formal user
K	Vice-President non-ferrous		X	Sept '04	X	
L-1	CEO & Vice President		X	Nov '04		
L-2	Adm. Director		X	Nov '04	X	
M	President		X	Sept '04	X	
N	Chief Mgr. Operations	X		April '04	X	X
O	Vice President		X	Sept '04	X	
P	President		X	Sept '04	X	

Note: n/a= not available; mgr. = manager; dir. = director; ph = phone; f2f = face to face

APPENDIX B: Characteristics of scrap metal wholesalers

I D	Turnover million USD	Emp loye es	Locatio n	Firm age (yr.)	Processi ng facilities	Importe r Exporte r	Broker	MR F	Metallic Consumer	Auto Shred der	Iron ferrou s	Other materials
A	175 M	320	Midwes t	100	15	X	3 trading offices			X	X	electronics
B	24 M	70	South	30	2	X		X				
C	+ 5,000 M	1,10 0	Midwes t & South	120	25	X	12 trading offices				X	
D	n/a	410	Midwes t	30	12					X	X	
E	n/a	25	South	20	1	X	X				X	
F	92 M	300	Midwes t	100	13	X	X	X		X	X	paper, electronics
G	n/a	n/a	Midwes t	n/a	1	X	3 trading offices	X	X			
H	n/a	60	Midwes t & China	10	2	X						
I	1,007 M	1,45 0	Midwes t	60	32	X	6 trading offices	X	X	X	X	electronics
J	10 – 25 M	35	Canada	90	1	X	X	n/a	n/a	n/a	X	electronics plastics, paper
K	65 M	304	Midwes t	90	10	X	X		X	X	X	
L	94 M	150	Midwes t	40	7	X	1 trading office	X			X	electronics
M	15 M	5	North East	25	n/a						X	
N	36 M	75	South	100	8		X	X		X	X	

ID	Turnover million USD	Employees	Location	Firm age (yr.)	Processing facilities	Importer/Exporter	Broker	MRF	Metallic Consumer	Auto Shredder	Iron ferrous	Other materials
O	34 M	50	Midwest	50	2			X				electronics
P	10 M	30	Mexico	25	n/a	X	1 trading office	n/a	n/a	n/a	X	plastics, wood

Sources: Interviews; the 2004 North American Scrap Metals Directory published by the Recycling Today Media Group located in Cleveland, OH; company websites; and the online-business content service Goliath (<http://goliath.eenext.com>).

Notes:

- Separate brokerage/offices are noted in the table above.
- MRF stands for Material Recovery Facility.
- Non-ferrous may include copper, brass, aluminum, used beverage cans, stainless steel, specialty metals, lead, nickel, magnesium, high temperature alloys, precious metals, tin, and zinc.

APPENDIX C: Additional explanatory case studies

ID	Organization	Function	Interview type	Date
Q-2	Web-based auction	VP and Director	Three phone, two f2f	April, May, June, Sept 04
R	Industry association	Director environmental affairs	phone	April '04

Note: ph = phone; f2f = face to face

APPENDIX D: Exploratory case studies

<i>ID</i>	<i>Organizations</i>	<i>Function</i>	<i>Contact</i>	<i>Date</i>
	Six academic d research experts			
UA	Large university in the Midwest	Professor in Food & Agricultural Policy	ph	Oct '03
UB	Large university in the Midwest	Associate Professor of Operations Management	f2f	Nov '03
UC	Large university in the Midwest	Professor Emeritus, economics	ph	Nov '03
UD	Large university in the Midwest	Professor in plastics and packaging	f2f	Feb '04
UE	Large university in the Netherlands	Environmental economist	ph.	March '04
UF	Large university in the Midwest	Assistant Professor, environmental economics	f2f	April '04
UG	Research firm / large university in the Southeast	President	f2f	Sept '04
	Three Generators			
GA	Large university in the Midwest	Recycling Manager	f2f	Oct '04
GB	Surplus store	Marketing and Sales Coordinator	f2f	Feb '04
GC	Recycling Board Canadian province	Research Analyst	f2f	Nov '03
	Five processors/consumers of recycled plastics			
PA	Manufacturer of polyethylene products	Division Manager	f2f	Nov '03
PB	Producer of recycled polypropylene/polyethylene resins	Sales & Marketing Development	f2f	Nov '03
PC	Manufacturers of plastic furniture	President	f2f	Nov '03
PD	Manufacturer of carpets	Manager of Environmental Affairs	f2f	Nov '03
PE	Producer of plastic food packaging	VC Manager – Governmental & environmental affairs	ph.	Feb '04
	One collector/ processor recycled paper			
PF	Solid waste service firm	General Manager	ph., f2f	Feb '04
	Remanufactures			
RA	Producer of refurbished cell phones	Vice President of sales	ph.	March '04
RB	Remanufactured toner cartridges and laser printer service	President	f2f	Nov '03

<i>ID</i>	<i>Organizations</i>	<i>Function</i>	<i>Contact</i>	<i>Date</i>
	Two consumers of non-ferrous scrap metal			
CA	Producers of brass casting alloys	Vice President	f2f	Sept '04
CB	recycler of copper nickel, precious metals	Mgr secondary copper markets	f2f	Sept '04
	Three brokerage firms			
BA	Trading company	Broker of copper NYMEX/COMEX	f2f	Sept '04
BB	Trading company	Broker of Eurodollars CME	f2f	Sept '04
BC	Trading company	Broker CME	f2f	Sept '04
	Three Internet ventures			
Q-1	Web-based auction	Commercial Services	ph.	April '04
IA	Online Supply/demand aggregator	Operations manager	ph.	April '04
IB	Real-time data feed services	Account Executive	f2f	Sept '04
IC	Government supported Internet exchange for recyclable materials	Recycling Specialist	ph.	Jan '04

APPENDIX E: Scrap metals sold at online auction

AC Electric Motors



Zorba 75-80



REFERENCES

- Abrahamson, E., & Fombrun, C. J. (1992). Forging the Iron Cage - Interorganizational Networks and the Production of Macro-Culture. *Journal of Management Studies*, 29(2), 175-194.
- Abrahamson, E., & Fombrun, C. J. (1994). Macrocultures - Determinants and Consequences. *Academy of Management Review*, 19(4), 728-755.
- Ackerman, F. (1997). *Why do we recycle : markets, values, and public policy*. Washington, D.C.: Island Press.
- Adant, I., & Gaspart, F. (2001, September 13-15). *The effects of reputation: a well-functioning market under quality uncertainty*. Paper presented at the International Society for New Institutional Economics (ISNIE 2001), Berkeley, California, USA.
- Adelaar, T. (2000). Electronic commerce and the implications for market structure: The example of the art and antiques trade. *Journal of Computer Mediated Communication*, 5(3).
- Akerlof, G. A. (2001). The Market for "Lemons": Quality Uncertainty and the Market Mechanism. In N. Barr (Ed.), *Economic theory and the welfare state* (Vol. 1. Theory, pp. 308-320). Cheltenham, U.K. and Northampton, Mass.: Elgar.
- Alchian, A. A., & Demsetz, H. (1972). Production, Information costs and Economic Organization. *American Economic Review*, 62(5), 777-795.
- AMA. (2004). *Marketing Glossary Dictionary*. Retrieved October 18, 2004, from <http://www.marketingpower.com/live/mg-dictionary.php>
- Ammelrooy, P. v. (2005, May 17, 2005). Revival van het kantoor in de binnenzak ; Microsoft: 'Internet is nog niet echt geschikt voor pda'. *de Volkskrant*, p. 9.
- Angehrn, A., Nabeth, T., & Subirana, B. (2001, 17-19 October). *Designing Virtual Communities to support E-Commerce adoption*. Paper presented at the e2001 eBusiness and eWork Conference, Venice.
- APC. (2003). *2003 National post-consumer plastics recycling report* (No. 1646): American Plastics Council.

- Argyres, N. S., & Liebeskind, J. P. (1999). Contractual commitments, bargaining power, and governance inseparability: Incorporating history into transaction cost theory. *Academy of Management Review*, 24(1), 49-63.
- Argyres, N. S., & Liebeskind, J. P. (2000). The role of prior commitment in governance choice. In N. J. Foss & V. Mahnke (Eds.), *Competence, governance, and entrepreneurship : advances in economic strategy research* (pp. xii, 339 p.). Oxford ; New York: Oxford University Press.
- Arrow, K. J. (1963). Uncertainty and the Welfare Economics of Medical Care. *American Economic Review*, 53(December), 967.
- Arrow, K. J. (1974). *The limits of organization*. New York: W. W. Norton.
- Arthur, W. B. (1989). Competing Technologies, Increasing Returns, and Lock-in by Historical Events. *Economic Journal*, 99(394), 116-131.
- Bailey, J. P. (1998). *Internet Price Discrimination: Self-Regulation, Public Policy, and Global Electronic Commerce* (Working Paper). College Park, MD: The Robert H. Smith School of Business, University of Maryland.
- Bajari, P., McMillan, R., & Tadelis, S. (2002). *Auctions versus Negotiations in Procurement: An Empirical Analysis*: Stanford University, Department of Economics.
- Baker, W. E. (1984). The Social Structure of a National Securities Market. *The American Journal of Sociology*, 89(4), 775-811.
- Bakos, J. Y. (1991). A Strategic Analysis of Electronic Marketplaces. *MIS Quarterly*, 15(3), 295-310.
- Bakos, J. Y. (1997). Reducing buyer search costs: Implications for electronic marketplaces. *Management Science*, 43(12), 1676-1692.
- Bakos, J. Y. (1998). The emerging role of electronic marketplaces on the Internet. *Communications of the ACM*, 41(8), 35-42.
- Barthelemy, J., & Quelin, B. V. (2000, September 22-24). *Contractual agreements and outsourcing: a transaction -cost analysis*. Paper presented at the Conference of the International Society for New Institutional Economics, Tübingen, Germany.
- Bartley, T. (2003). Certifying forests and factories: States, social movements, and the rise of private regulation in the apparel and forest products fields. *Politics & Society*, 31(3), 433-464.

- Barzel, Y. (1982). Measurement Cost and the Organization of Markets. *Journal of Law and Economics*, 25(1), 27-48.
- Barzel, Y. (1997). *Economic analysis of property rights* (2nd ed.). Cambridge ; New York: Cambridge University Press.
- Barzel, Y. (2002, Aug. 12). *Organizational Forms and Measurement Costs*. Paper presented at the International Society for New Institutional Economics (ISNIE).
- Baum, J. A. C., & Dutton, J. E. (1996). Introduction. *Advances in Strategic Management*, 13.
- Beck, R. W. (2001). *U.S. Recycling Economic Information Study. Prepared for The National Recycling Coalition*. Washington, DC: The National Recycling Coalition.
- Benbasat, I., Goldstein, D. K., & Mead, M. (1987). The Case Research Strategy in Studies of Information Systems. *MIS Quarterly*, 11(3), 368.
- Benjamin, R., & Wigand, R. (1995). Electronic markets and virtual value chains on the information superhighway. *Sloan Management Review*, 36(2), 62-72.
- Bensaou, M., & Venkatraman, N. (1995). Configurations of Interorganizational Relationships - a Comparison between Us and Japanese Automakers. *Management Science*, 41(9), 1471-1492.
- Berryman, K., & Heck, S. (2001, March 28, 2001). Is The Third Time The Charm For B2B? *InternetWeek*.
- Bettenhausen, K., & Murnighan, J. K. (1985). The Emergence of Norms in Competitive Decision-Making Groups. *Administrative Science Quarterly*, 30(3), 350-372.
- Bichler, M., Kalagnanam, J., Katircioglu, K., King, A. J., Lawrence, R. D., Lee, H. S., et al. (2002). Applications of flexible pricing in business-to-business electronic commerce. *IBM Systems Journal*, 41(2), 287.
- Biggart, N. W., & Beamish, T. D. (2003). The economic sociology of conventions: Habit, custom, practice, and routine in market order. *Annual Review of Sociology*, 29, 443-464.
- Biggart, N. W., & Delbridge, R. (2004). Systems of exchange. *Academy of Management Review*, 29(1), 28-49.
- Bijker, W. E. (1995). *Of bicycles, bakelites, and bulbs : toward a theory of sociotechnical change*. Cambridge, Mass.: MIT Press.

- Bijker, W. E., Hughes, T. P., & Pinch, T. J. (Eds.). (1987). *The Social construction of technological systems : new directions in the sociology and history of technology*. Cambridge, Mass.: MIT Press.
- Blois, K. J. (1999). Trust in business to business relationships: An evaluation of its status. *Journal of Management Studies*, 36(2), 197-215.
- Bose, S., Duan, Z., & Lu, S. (2003, November). *An XML-based Framework for Rapid Development of Interoperable Trading Systems*. Paper presented at the the 7th IASTED International Conference on Software Engineering and Applications (SEA'2003), Marina del Rey, CA, USA.
- Bourdieu, P. (1977). *Outline of a theory of practice*. Cambridge ; New York: Cambridge University Press.
- Bourdieu, P. (1998). *Practical reason : on the theory of action*. Stanford, Calif.: Stanford University Press.
- Brynjolfsson, E., & Hitt, L. (1996). Paradox lost? Firm-level evidence on the returns to information systems spending. *Management Science*, 42(4), 541-558.
- Brynjolfsson, E., & Hitt, L. (2000). Beyond Computation: Information Technology, Organizational Transformation and Business Performance. *Journal of Economic Perspectives*, 14(4), 23-48.
- Brynjolfsson, E., & Smith, M. D. (2000). Frictionless commerce? A comparison of Internet and conventional retailers. *Management Science*, 46(4), 563-585.
- Buckley, P., Montes, S., Henry, D., Dalton, D., Gill, G., Dumagan, J., et al. (2000). *Digital Economy 2000*. Washington, D.C.: Economics and Statistics Administration, U.S. Department of Commerce.
- Bygrave, W. D., Lange, J. E., Kotha, R. R., & Stock, W. (2001). *Venture Capital Investments and the Growth of Revolutionary New Industries* (Frontiers of Entrepreneurship Research): Babson College.
- Byrd, T. A., & Davidson, N. W. (2003). Examining possible antecedents of IT impact on the supply chain and its effect on firm performance. *Information & Management*, 41(2), 243-255.
- Canfax. (2003). *Price discovery for the North American beef sector: a review of the economic literature* (Canfax Research Services). Calgary, Alberta: Canfax Research Services.

- Capps, J. O., Love, H. A., Williams, G. W., & Adams, W. L. (1999). Examining Packer Choice of Slaughter Cattle Procurement and Pricing Methods. *Agricultural and Resource Economics Review*, 28(1), 11-25.
- Carson, D., Gilmore, A., Perry, C., & Gronhaug, K. (2001). *Qualitative marketing research*. London ; Thousand Oaks, Calif.: SAGE.
- Carter, C. R., Kaufmann, L., Beall, S., Carter, P. L., Hendrick, T. E., & Petersen, K. J. (2004). Reverse auctions - grounded theory from the buyer and supplier perspective. *Transportation Research: Part E*, 40(3), 229-254.
- Casadesus-Masanell, R., & Spulber, D. F. (2002). The Fable of Fisher Body. In D. F. Spulber (Ed.), *Famous fables of economics : myths of market failures* (pp. 158-189). Malden, MA: Blackwell Publishers.
- Cassidy, J. (2002). *Dot.con : the greatest story ever sold* (1st ed.). New York: HarperCollins.
- Census. (2004). *Electronic Markets and Agents and Brokers: 2002* (2002 Economic Census, Wholesale Trade, Industry Series No. EC02-42I-19): U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau.
- Chisholm, D. W. (1989). *Coordination without hierarchy : informal structures in multiorganizational systems*. Berkeley: University of California Press.
- Choudhury, V., Hartzel, K. S., & Konsynski, B. R. (1998). Uses and consequences of electronic markets: An empirical investigation in the aircraft parts industry. *MIS Quarterly*, 22(4), 471-507.
- Christiaanse, E., & Markus, M. L. (2002). *Business-to-business electronic marketplaces and the structure of channel relationships*. Paper presented at the International Conference on Information Systems, Barcelona, Spain.
- Cieslak, D. M., & Winkle, M. V. (2004). Carry Your Office in the Palm of Your Hand. *Journal of Accountancy*, 198(2), 52.
- CIWMB. (1996). *Market Status Report: Secondary Materials Exports* (CIWMB Publications No. 421-96-064). Sacramento, CA: California Integrated Waste Management Board.
- Claro, D. P., Hagelaar, G., & Omta, O. (2003). The determinants of relational governance and performance: How to manage business relationships? *Industrial Marketing Management*, 32(8), 703-716.

- Clemons, E. K., Reddi, S. P., & Row, M. C. (1993). The Impact of Information Technology on the Organization of Economic Activity: The "Move to the Middle" Hypothesis. *Journal of Management Information Systems*, 10(2), 9-35.
- Coase, R. H. (1937). The nature of the firm. *Economica*, 4, 386-405.
- Cohen, M. D., Burkhart, R., Dosi, G., Egidi, M., Marengo, L., Warglien, M., et al. (1996). Routines and Other Recurring Action Patterns of Organizations: Contemporary Research Issues. *Industrial & Corporate Change*, 5(3), 653-688.
- Constantinides, E. (2004). Strategies for surviving the Internet meltdown: The case of two Internet incumbents. *Management Decision*, 42(1), 89-107.
- Corsten, D., & Hofstetter, J. (2001). The future of online exchanges. *ECR Journal*, 1(1).
- Crowston, K., & Myers, M. D. (2004). Information technology and the transformation of industries: three research perspectives. *Journal of Strategic Information Systems*, 13(1), 5-28.
- Curlee, T. R., Publication: New York and London: Greenwood Press, P., 1986, Y., Description: xiv, 0-275-92376-2, S. N. I., plastics, A. A. t. p. a. w., et al.
- Dacin, M. T., Ventresca, M. J., & Beal, B. D. (1999). The embeddedness of organizations: Dialogue & directions. *Journal of Management*, 25(3), 317-356.
- Daft, R. L., & Lengel, R. H. (1986). Organizational information requirements, media richness and structural design. *Management Science*, 32(5), 554-571.
- Daft, R. L., & Lengel, R. H. (Eds.). (1984). *Information richness: a new approach to managerial information processing and organization design* (Vol. 6). Greenwich, Connecticut: JAI Press.
- Dai, Q. Z., & Kauffman, R. J. (2002). Business models for Internet-based B2B electronic markets. *International Journal of Electronic Commerce*, 6(4), 41-72.
- Davenport, T. H., & Cantrell, S. (2001). *Do Independent e-markets Have a Future?* (Outlook Point of View).
- Day, G. S., Fein, A. J., & Ruppertsberger, G. (2003). Shakeouts in Digital Markets: Lessons from B2B exchanges. *California Management Review*, 45(2), 131 - 153.
- Desanctis, G., & Poole, M. S. (1994). Capturing the Complexity in Advanced Technology Use - Adaptive Structuration Theory. *Organization Science*, 5(2), 121-147.

- Dewan, S., & Hsu, V. (2004). Adverse selection in electronic markets: Evidence from online stamp auctions. *Journal of Industrial Economics*, 52(4), 497-516.
- Dholakia, U. M. (2005). The usefulness of bidders' reputation ratings to sellers in online auctions. *Journal of Interactive Marketing*, 19(1), 31-40.
- Dimaggio, P. (1994). Introduction, Meaning and Measurement in the Sociology of the Culture. *Poetics*, 22(4), 263-267.
- DiMaggio, P., & Louch, H. (1998). Socially embedded consumer transactions: For what kinds of purchases do people most often use networks? *American Sociological Review*, 63(5), 619-637.
- Dimaggio, P. J., & Powell, W. W. (1983). The Iron Cage Revisited - Institutional Isomorphism and Collective Rationality in Organizational Fields. *American Sociological Review*, 48(2), 147-160.
- Dobler, D. W., & Burt, D. N. (1996). *Purchasing and supply management : text and cases* (6th ed.). New York: McGraw-Hill.
- Dosi, G. (1982). Technological Paradigms and Technological Trajectories - a Suggested Interpretation of the Determinants and Directions of Technical Change. *Research Policy*, 11(3), 147-162.
- Douma, S. W., & Schreuder, H. (1991). *Economic approaches to organizations*. Hertfordshire [England]: Prentice Hall International.
- Drumwright, M. E. (1994). Socially Responsible Organizational Buying - Environmental Concern as a Noneconomic Buying Criterion. *Journal of Marketing*, 58(3), 1-19.
- Duh, R.-R., Jamal, K., & Sunder, S. (2002). Control and Assurance in E-Commerce: Privacy, Integrity, and Security at eBay. *Taiwan Accounting Review*, 3(1), 1-27.
- Dyer, J. H., & Singh, H. (1998). The relational view: Cooperative strategy and sources of interorganizational competitive advantage. *Academy of Management Review*, 23(4), 660-679.
- Economist, T. (2005a, May 17). Attack of the BlackBerry killers? *The Economist*.
- Economist, T. (2005b, May 12). Mobile e-mail. *The Economist*.
- Eisenhardt, K. M. (1989). Building Theories from Case-Study Research. *Academy of Management Review*, 14(4), 532-550.

- Englander, E. J. (1988). Technology and Williamson, Oliver Transaction Cost Economics. *Journal of Economic Behavior & Organization*, 10(3), 339-353.
- Fama, E. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, 25, 383-417.
- Feldman, M. S., & Pentland, B. T. (2003). Reconceptualizing organizational routines as a source of flexibility and change. *Administrative Science Quarterly*, 48(1), 94-118.
- Fenton, M. (1997). *Iron and Steel Scrap*.
- Fenton, M. D. (1998). *Iron and steel recycling in the United States in 1998* (Flow Studies for Recycling Metal Commodities in the United States). Reston, Virginia: U.S. Department of the Interior, U.S. Geological Survey (USGS).
- Firestone, W. A. (1993). Alternative arguments fro generalizing from data as applied to qualitative research. *Educational Researcher*, 22(4), 16-23.
- First-Research. (2005, April 4). *Scrap Metals-Recycling Industry Profile*, from <http://www.firstresearch.com/Industry-Research/Scrap-Metals-Recycling.html>
- Flanagin, A. J., Monge, P., & Fulk, J. (2001). The value of formative investment in organizational federations. *Human Communication Research*, 27(1), 69-93.
- Foray, D. (1994). Users, Standards and the Economics of Coalitions and Committees. *Information Economics and Policy*, 6(3-4), 269-293.
- Fulk, J., Schmitz, J., & Steinfield, C. (1990). A social influence model of technology use. In J. Fulk & C. W. Steinfield (Eds.), *Organizations and communication technology* (pp. 117-141). Newbury Park, Calif.: Sage Publications.
- Fulk, T., Flanagin, A. J., Kalman, M. E., Monge, P. R., & Ryan, T. (1996). Connective and communal public goods in interactive communication systems. *Communication Theory*, 6(1), 60-87.
- Gale, & Group (Eds.). (2001). *Scrap and Waste Materials* (3 ed.).
- Gallouj, F., & Weinstein, O. (1997). Innovation in services. *Research Policy*, 26(4-5), 537-556.
- Gander, J., & Rieple, A. (2004). How Relevant is Transaction Cost Economics to Inter-Firm Relationships in the Music Industry? *Journal of Cultural Economics*, 28(1), 57.

- Garcia-Dastugue, S. J., & Lambert, D. M. (2003). Internet-enabled coordination in the supply chain. *Industrial Marketing Management*, 32(3), 251-263.
- Garicano, L., & Kaplan, S. N. (2000). *The Effects of Business-to-Business E-Commerce on Transaction Costs* (No. Working Paper 8017). Cambridge, MA: National Bureau of Economic Research.
- Garicano, L., & Kaplan, S. N. (2001). The Effects of Business-to-Business E-Commerce on Transaction Costs. *Journal of Industrial Economics*, 49(4), 463.
- Gebauer, J., & Zagler, M. (2000). *Assessing the Status Quo and Future of B2B E-Commerce*. Berkeley, CA: Fisher Center for IT & Marketplace Transformation, Haas School of Business, University of California.
- Gersick, C. J. G. (1988). Time and Transition in Work Teams - toward a New Model of Group Development. *Academy of Management Journal*, 31(1), 9-41.
- Gertler, M. S. (2003). Tacit knowledge and the economic geography of context, or The undefinable tacitness of being (there). *Journal of Economic Geography*, 3(1), 75-99.
- Geyskens, I., Steenkamp, J., & Kumar, N. (1998). Generalizations about trust in marketing channel relationships using meta-analysis. *International Journal of Research in Marketing*, 15(3), 223-248.
- Giaglis, G. M., Klein, S., & O'Keefe, R. M. (2002). The role of intermediaries in electronic marketplaces: developing a contingency model. *Information Systems Journal*, 12(3), 231-246.
- Giddens, A. (1979). *Central problems in social theory : action, structure, and contradiction in social analysis*. Berkeley: University of California Press.
- Giddens, A. (1984). *The constitution of society : outline of the theory of structuration*. Berkeley: University of California Press.
- Glaser, B. G. (1978). *Theoretical sensitivity : advances in the methodology of grounded theory*. Mill Valley, Calif.: Sociology Press.
- Glaser, B. G., & Strauss, A. L. (1967). *The discovery of grounded theory; strategies for qualitative research*. Chicago,: Aldine Pub. Co.
- Golden-Biddle, K., & Locke, K. D. (1997). *Composing qualitative research*. Thousand Oaks, Calif.: Sage Publications.

- Goodrich, M. (2000, March). Mini-Mills Boast Major Scrap Appetite. *Recycling Today*.
- Granados, N. F., Gupta, A., & Kauffman, R. J. (2005, January). *The impact of IT on market information and transparency: a theoretical framework*. Paper presented at the Hawaii International Conference on Systems Science,, Kona, HI.
- Granovetter, M. (1985). Economic-Action and Social-Structure - the Problem of Embeddedness. *American Journal of Sociology*, 91(3), 481-510.
- Grewal, R., Comer, J. M., & Mehta, R. (2001). An investigation into the antecedents of organizational participation in business-to-business electronic markets. *Journal of Marketing*, 65(3), 17-33.
- Grossman, S. J. (1990). *Report for market volatility and investor confidence panel* (G2-1-G2-17): New York Stock Exchange.
- Grover, V. (1993). An Empirically Derived Model for the Adoption of Customer-Based Interorganizational Systems. *Decision Sciences*, 24(3), 603-640.
- Grover, V., & Ramanlal, P. (1999). Six myths of information and markets: Information technology networks, electronic commerce, and the battle for consumer surplus. *MIS Quarterly*, 23(4), 465-495.
- Gruver, G., & Giarratani, F. (2005). Modeling Geographic Ferrous Scrap Markets: Regional Prices and Interregional Transactions in the United States. *Journal of Regional Science*, 45(2), 313-341.
- Gulati, R. (1995). Social structure and alliance formation patterns: A longitudinal analysis. *Administrative Science Quarterly*, 40(4), 619-652.
- Gulati, R., & Gargiulo, M. (1999). Where do interorganizational networks come from? *American Journal of Sociology*, 104(5), 1439-1493.
- Gupta, A. K., & Lad, L. J. (1983). Industry Self-Regulation - an Economic, Organizational, and Political-Analysis. *Academy of Management Review*, 8(3), 416-425.
- Gurbaxani, V., & Whang, S. (1991). The impact of information systems on organizations and markets. *Communications of the ACM*, 34(1), 59 - 73.
- Harler, C. (2001). Positioning for the Future. *Recycling Today*.
- Hawkins, R., & Verhoest, P. (2002). A transaction structure approach to assessing the dynamics and impacts of 'business-to-business' electronic commerce. *Journal of Computer-Mediated Communication*, 7(3).

- Heeter, C. (2000). Interactivity in the Context of Designed Experiences. *Journal of Interactive Advertising*, 1(1).
- Heide, J. B., & John, G. (1990). Alliances in Industrial Purchasing - the Determinants of Joint Action in Buyer-Supplier Relationships. *Journal of Marketing Research*, 27(1), 24-36.
- Heide, J. B., & John, G. (1992). Do Norms Matter in Marketing Relationships. *Journal of Marketing*, 56(2), 32-44.
- Heide, J. B., & Miner, A. S. (1992). The Shadow of the Future - Effects of Anticipated Interaction and Frequency of Contact on Buyer-Seller Cooperation. *Academy of Management Journal*, 35(2), 265-291.
- Helm, B. (2005, July 8). Web Surfers' Sense of Siege. *Business Week*.
- Henderson, J., Dooley, F., & Akridge, J. (2004). Internet and E-Commerce Adoption by Agricultural Input Firms. *Review Agricultural Economics*, 26(4), 505-520.
- Hess, B. C. M., & Kemerer, C. F. (1994). Computerized loan origination system: An industry case study of the electronic markets. *MIS Quarterly*, 18(3), 251.
- Hippel, E. v. (1988). *The sources of innovation*. New York: Oxford University Press.
- Hoffman, A. J. (2001). Linking organizational and field-level analyses - The diffusion of corporate environmental practice. *Organization & Environment*, 14(2), 133-156.
- Hoffman, A. J., & Ocasio, W. (2001). Not all events are attended equally: Toward a middle-range theory of industry attention to external events. *Organization Science*, 12(4), 414-434.
- Houston, M. B., & Johnson, S. A. (2000). Buyer-supplier contracts versus joint ventures: Determinants and consequences of transaction structure. *Journal of Marketing Research*, 37(1), 1-15.
- Humphrey, J., Mansell, R., Paré, D., & Schmitz, H. (2003). *The Reality of E-commerce with Developing Countries*. Brighton / London, United Kingdom: IDS / LSE.
- Huttenlocher, D. (November 2001). *On Addressing the Market Participants' Paradox*, from <http://www.cs.cornell.edu/~dph/talks/marketparadox.pdf>
- IRS. *Scrap Metal Industry*. Retrieved May 22, 2005, from <http://www.irs.gov/businesses/page/0,,id%3D7090,00.html>

- ISM, & Forrester. (2001-2003). *Institute for Supply Management (ISM) /Forrester Research Report On Technology in Supply Management Quarterly Survey*.
- ISRI. (1993a). *Recycling Nonferrous Scrap Metals*. Washington, DC: Institute of Scrap Recycling Industries, Inc.
- ISRI. (1993b). *Recycling Paper*. Washington, DC: Institute of Scrap Recycling Industries, Inc.
- ISRI. (1993c). *Recycling scrap iron and steel*. Washington, DC: Institute of Scrap Recycling Industries, Inc.
- ISRI. (1996). *Scrap Recycling: Where Tomorrow Begins*. Washington, DC: Institute of Scrap Recycling Industries, Inc.
- ISRI. (2004). *Company/Industry Profile*. Retrieved 03/04/2004, 2004
- Ivens, B. S., & Blois, K. J. (2004). Relational exchange norms in marketing: a critical review of Macneil's contribution. *Marketing Theory*, 4(3), 239.
- Jap, S. D. (2002). Online Reverse Auctions: Issues, Themes, and Prospects for the Future. *Journal of the Academy of Marketing Science*, 30(4), 506.
- Jap, S. D. (2003). An Exploratory Study of the Introduction of Online Reverse Auctions. *Journal of Marketing*, 67(3), 96.
- Jap, S. D., & Mohr, J. J. (2002). Leveraging Internet Technologies in B2B Relationships. *California Management Review*, 44(4), 24.
- Jasperson, J. S., Carter, P. E., & Zmud, R. W. (2005). A comprehensive conceptualization of post-adoptive behaviors associated with information technology enabled work systems. *Mis Quarterly*, 29(3), 525-557.
- Johansson, A., & Holappa, L. (2004). From megaplants to mini-mills--a trend in steelmaking--a prospect for papermaking. *Resources, Conservation and Recycling*, 40(2), 173-183.
- Johnson, B. M., & Rice, R. E. (1984). Reinvention in the innovation process: the case of word processing. In R. E. Rice (Ed.), *The New media : communication, research, and technology* (pp. 157-183). Beverly Hills: Sage Publications.
- Johnston, W. J., & Lewin, J. E. (1994). *A review and integration of research on organizational buying behavior*. Cambridge, Mass.: Marketing Science Institute.

- Johnstone, N. (2003). *Workshop on the economics of waste: market failure and barriers in secondary material markets* (No. ENV/EPOC/WGWPR(2003)11). Paris: OECD.
- Jones, C., Hesterly, W. S., & Borgatti, S. P. (1997). A general theory of network governance: Exchange conditions and social mechanisms. *Academy of Management Review*, 22(4), 911-945.
- Joshi, A. W., & Stump, R. L. (1999). Transaction cost analysis: Integration of recent refinements and an empirical test. *Journal of Business to Business Marketing*, 5(4), 37.
- Kambil, A., & Heck, E. v. (1998). Re-engineering the Dutch Flower Auctions: A Framework for Analyzing Exchange Organizations. *Information Systems Research*, 9(1), 1-19.
- Kaplan, S., & Sawhney, M. (2000). E-hubs: The new B2B marketplaces. *Harvard Business Review*, 78(3), 97-103.
- Katka, S. J., Temkin, B. D., & Wegner, L. (2000). *B2B Auctions Go Beyond Price*: Forrester Research, Inc.
- Kauffman, R. J., & Wang, B. (2003). *A Survival Theory of Internet Firm Duration* (Working paper No. 03-35). Minneapolis, MN: Carlson School of Management, University of Minnesota.
- Kauffman, R. J., Wang, B., & Miller, T. (2002, January 7-10). *Strategic 'Morphing' and the Survivability of E-Commerce Firms*. Paper presented at the 35th Hawaii International Conference on System Sciences, Big Island, Hawaii.
- Kettinger, W. J., & Grover, V. (1997). The Use of Computer-mediated Communication in an Interorganizational Context. *Decision Sciences*, 28(3), 513-555.
- Klein, B., Crawford, R. G., & Alchian, A. A. (1978). Vertical Integration, Appropriable Rents, and the Competitive Contracting Process. *Journal of Law and Economics*, 21(2), 297-326.
- Klein, L. R. (1998). Evaluating the potential of interactive media through a new lens: Search versus experience goods. *Journal of Business Research*, 41(3), 195-203.
- Klein, S., & O'Keefe, R. M. (1998). The Impact of the Web on Auctions: Some Empirical Evidence and Theoretical Considerations. *International Journal of Electronic Commerce*, 3(3), 7-20.

- Klemperer, P. (1995). Competition When Consumers Have Switching Costs - an Overview with Applications to Industrial-Organization, Macroeconomics, and International-Trade. *Review of Economic Studies*, 62(4), 515-539.
- Klemperer, P. (2002). What really matters in auction design. *Journal of Economic Perspectives*, 16(1), 169-189.
- Knoke, D. (1990). *Political networks : the structural perspective*. Cambridge [England] ; New York: Cambridge University Press.
- Kotha, S., Rajgopal, S., & Rindova, V. (2001). Reputation Building and Performance: An Empirical Analysis of the Top-50 Pure Internet Firms, *European Management Journal* (Vol. 19, pp. 571).
- Kraut, R., Steinfield, C., Chan, A. P., Butler, B., & Hoag, A. (1999). Coordination and virtualization: The role of electronic networks and personal relationships. *Organization Science*, 10(6), 722-740.
- Kurov, A., & Lasser, D. J. (2004). Price Dynamics in the Regular and E-Mini Futures Markets. *Journal of Financial and Quantitative Analysis*, 39(2), 365-384.
- Lane, P. J., & Lubatkin, M. (1998). Relative absorptive capacity and interorganizational learning. *Strategic Management Journal*, 19(5), 461-477.
- Langlois, R. N. (1986). *Economics as a process : essays in the new institutional economics*. Cambridge [Cambridgeshire] ; New York: Cambridge University Press.
- LaRose, R., & Hoag, A. (1996). Organizational Adoptions of the Internet and the Clustering of Innovations. *Journal of Telematics and Informatics*, 13(1), 49-61.
- Latham, S. (2000). *Evaluating the Independent Trading Exchanges*. Boston, Mass.: AMR Research.
- Leffler, K. B., Rucker, R. R., & Munn, I. A. (2003). *The choice among sales procedures: auction v. negotiated sales of private timber*. Seattle, Washington, USA: Department of Economics, University of Washington.
- Leiblein, M. J. (2003). The choice of organizational governance form and performance: Predictions from transaction cost, resource-based, and real options theories. *Journal of Management*, 29(6), 937-961.
- Lennstrand, B., Frey, M., & Johansen, M. (2001, July 2-3). *Analyzing B2B eMarkets - the Impact of Product and Industry Characteristics on Value Creation and Business*

Strategies. Paper presented at the International Telecommunication Society (ITS) Asia-Indian Ocean Regional Conference, Perth, Australia.

Lucking-Reiley, D., & Spulber, D. F. (2000). *Business-to-Business Electronic Commerce* (No. 00-w16): Vanderbilt - Economic and Business Administration.

Lusch, R. F., & Brown, J. R. (1996). Interdependency, contracting, and relational behavior in marketing channels. *Journal of Marketing*, 60(4), 19-38.

Madhavan, A., & Panchapagesan, V. (2002). The First Price of the Day: Auctions Are Not Practical for Trading All Securities. *Journal of Portfolio Management*, 28(2), 101-111.

Mahnke, V. (2001, June 12-15). *Why theories of firm boundaries need an evolutionary process dimension?* Paper presented at the Nelson and Winter Conference, Aalborg.

Majchrzak, A., Rice, R. E., Malhotra, A., King, N., & Ba, S. L. (2000). Technology adaptation: The case of a computer-supported inter-organizational virtual team. *Mis Quarterly*, 24(4), 569-600.

Malkiel, B. G. (2003). The efficient market hypothesis and its critics. *Journal of Economic Perspectives*, 17(1), 59-82.

Malone, T. W., & Crowston, K. (1994). The Interdisciplinary Study of Coordination. *Acm Computing Surveys*, 26(1), 87-119.

Malone, T. W., Yates, J., & Benjamin, R. I. (1987). Electronic Markets and Electronic Hierarchies. *Communications of the ACM*, 30(6), 484-497.

Mandjak, T., & Simon, J. (2004). *Integrated Value Model to Support Business Relationship Management*. Paper presented at the ISBM B-to-B Academic Conference, Boston.

March, J. G., & Simon, H. A. (1958). *Organizations*. New York,: Wiley.

Markus, M. L. (1983). Power, Politics, and MIS Implementation. *Communications of the ACM*, 26(6), 430-444.

Markus, M. L. (1994). Electronic Mail as the Medium of Managerial Choice. *Organization Science*, 5(4), 502-527.

Markus, M. L. (2004). Technochange management: using IT to drive organizational change. *Journal of Information Technology*, 19(1), 4-20.

- Markus, M. L., & Lee, A. S. (1999). Special issue on Intensive Research in Information Systems: Using qualitative, interpretive, and case methods to study information technology - Foreword. *MIS Quarterly*, 23(1), 35-38.
- Marley, M. (2000, March 15, 2000). *Scrap executives differ on e-commerce*, 2004
- Martens, M. (1998). Price Discovery in High and Low Volatility Periods: Open Outcry versus Electronic Trading. *Journal of International Financial Markets, Institutions and Money*, 8(3-4), 243-260.
- Martinez, R. J., & Dacin, M. T. (1999). Efficiency motives and normative forces: Combining transactions costs and institutional logic. *Journal of Management*, 25(1), 75-96.
- Mathews, J. A. (2001, June). *Resources, routines and interfirm relations: Entrepreneurial and evolutionary dynamics within an Industrial Market System*. Paper presented at the Danish Research Unit for Industrial Dynamics (DRUID) Summer conference, Aalborg, Denmark.
- Mathiesen, H. (1997). *Exhibition: Decomposing costs into transaction costs and production cost*. Retrieved November 4, 2004, from http://www.encycogov.com/B11ResearchTraditions/TCE/Exhi_1DecomposeTC.asp
- Merriam-Webster Inc. (1995). *Webster's new American dictionary*. New York: Smithmark.
- Miles, M. B., & Huberman, A. M. (1994). *Qualitative data analysis : an expanded sourcebook* (2nd ed.). Thousand Oaks: Sage Publications.
- Milgrom, P. R., & Roberts, J. (1992). *Economics, organization, and management*. Englewood Cliffs, N.J.: Prentice-Hall.
- Miller, N., Resnick, P., & Zeckhauser, R. (2005). Eliciting Informative Feedback: The Peer-Prediction Method. *Management Science*, 51(9), 1359-1373.
- Monteverde, K., & Teece, D. J. (1982). Supplier switching costs and vertical integration in the automobile industry. *Bell Journal of Economics*, 13(1), 206-213.
- Moodley, S. (2003). The potential of Internet-based business-to-business electronic commerce for a 'technology follower': the case of the South African apparel sector. *International Journal of Internet and Enterprise Management*, 1(1).
- Morgan, R. M., & Hunt, S. D. (1994). The Commitment-Trust Theory of Relationship Marketing. *Journal of Marketing*, 58(3), 20-38.

- Morrison, S., & Waters, R. (2005, 7 June). Jobs steps forward for 'big deal'. *Financial Times*, p. 25.
- Muzzi, C., & Kautz, K. (2003, October 6-8). *Information and communication technologies diffusion in industrial districts: an interpretive approach*. Paper presented at the IFIP TC8/WG8.6 Working Conference on the Diffusion and Adoption of Networked Information Technologies, Copenhagen, Denmark.
- Nelson, R. R., & Winter, S. G. (1982). *An Evolutionary Theory of Economic Change*. London: Belknap Press of Harvard University.
- Nelson, R. R., & Winter, S. G. (2002). Evolutionary theorizing in economics. *Journal of Economic Perspectives*, 16(2), 23-46.
- NERC. (1998). *Recycling Economic Information Project: Final Report*. Brattleboro, VT: Northeast Recycling Council.
- Niosi, J. (1998). Note de recherche; The Dissemination of New Routines--Toward an Evolutionary Approach. *Management International*, 3(1), 65-71.
- North, D. C. (1977). Markets and other allocation systems in history: The challenge of Karl Polanyi. *Journal of European Economic History*, 6, 703-716.
- North, D. C. (1981). *Structure and change in economic history* (1st ed.). New York: Norton.
- North, D. C. (1990). *Institutions, institutional change, and economic performance*. Cambridge ; New York: Cambridge University Press.
- North, D. C., & Thomas, R. P. (1973). *The rise of the Western world; a new economic history*. Cambridge [Eng.]: University Press.
- OECD. (2002). *Measuring the information economy 2002* (OECD Publications No. 81855 2002). Paris: Organisation for economic co-operation and development.
- OECD. (2003). *Implementing environmental fiscal reform: Income Distribution and Sectoral Competitiveness Issues* (No. COM/ENV/EPOC/DAFFE/CFA(2002)76/FINAL). Paris: Environment Directorate for Financial, Fiscal and Enterprise Affairs, Organisation for Economic Co-operation and Development (OECD).
- Oliver, C. (1990). Determinants of Interorganizational Relationships - Integration and Future-Directions. *Academy of Management Review*, 15(2), 241-265.

- Olson, M., Jr. (1965). *The logic of collective action*. Cambridge, MA: Harvard University Press.
- Olson, M., Jr. (1982). *The rise and decline of nations: Economic growth, stagflation, and social rigidities*. New Haven, CT: Yale University Press.
- Ong, S. E. (2004). *Price Discovery in Real Estate Auctions: The Story of Unsuccessful Attempts*: <http://ssrn.com/abstract=525102>.
- Orlikowski, W., & Baroudi, J. (1991). Studying information technology in organizations: research approaches and assumptions. *Information Systems Research*, 2(1), 1-28.
- Orlikowski, W., & Robey, D. (1991). Information Technology and the Structuring of Organizations. *Information Systems Research*, 2(2), 143.
- Orlikowski, W. J. (1992). The Duality of Technology - Rethinking the Concept of Technology in Organizations. *Organization Science*, 3(3), 398-427.
- Orlikowski, W. J. (1996). Improvising organizational transformation over time: A situated change perspective. *Information Systems Research*, 7(1), 63-92.
- Orlikowski, W. J. (2000). Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations. *Organization Science*, 11(4), 404.
- Orlikowski, W. J., Yates, J., Okamura, K., & Fujimoto, M. (1995). Shaping Electronic Communication - the Metastructuring of Technology in the Context of Use. *Organization Science*, 6(4), 423-444.
- PA-DEP. (2005). *Recycling saves energy*. Retrieved 27 May, 2005, from <http://www.dep.state.pa.us/dep/deputate/airwaste/wm/RECYCLE/FACTS/benefits3.htm>
- Pare, D. J. (2003). Does this site deliver? B2B e-commerce services for developing countries. *Information Society*, 19(2), 123-134.
- Parkhe, A. (1993). "Messy" Research, methodological predispositions, and theory development in international joint ventures. *Academy of Management Review*, 18(2), 227-268.
- Patton, M. Q. (1987). *How to use qualitative methods in evaluation*. Newbury Park, Calif.: Sage Publications.
- Pauleen, D. J., & Yoong, P. (2001). Relationship building and the use of ICT in boundary-crossing virtual teams: a facilitator's perspective. *Journal of Information Technology*, 16(4), 205-220.

- Pavlou, P. A. (2002). Institution-based trust in interorganizational exchange relationships: the role of online B2B marketplaces on trust formation. *Journal of Strategic Information Systems*, 11(3-4), 215-243.
- Pavlou, P. A., & Gefen, D. (2004a). Building effective online marketplaces with institution-based trust. *Information Systems Research*, 15(1), 37-59.
- Pavlou, P. A., & Gefen, D. (2004b). Building Effective Online Marketplaces with Institution-Based Trust. *Information Systems Research*, 15(1), 37-59.
- Perry, C., Riege, A., & Brown, L. (1999). Realism's role among scientific paradigms in marketing research. *Irish Marketing Review*, 12, 16.
- Pinch, T. J., & Bijker, W. E. (1987). The social construction of facts and artifacts: or how the sociology of science and the sociology of technology might benefit from each other. In W. E. Bijker, T. P. Hughes & T. J. Pinch (Eds.), *The Social construction of technological systems : new directions in the sociology and history of technology* (pp. 17-50). Cambridge, Mass.: MIT Press.
- Pinker, E. J., Seidmann, A., & Vakrat, Y. (2003). Managing Online auctions: Current business and research issues. *Management Science*, 49(11), 1457-1484.
- Platts. (2005). *Platts Metals Alert*. Retrieved 6 June, 2005, from <http://www.platts.com/Metals/Real-Time%20Information/Metals%20Alert/>
- Podolny, J. M. (1994). Market Uncertainty and the Social Character of Economic Exchange. *Administrative Science Quarterly*, 39(3), 458-483.
- Polanyi, K. (1944). *The great transformation: the political and economic origins of our time*. Boston: Beacon Press.
- Polanyi, K., Arensberg, C. M., & Pearson, H. W. (Eds.). (1957). *Trade and market in the early empires; economies in history and theory*. Glencoe, Ill.: Free Press.
- Polanyi, M. (1966). *The tacit dimension* ([1st] ed.). Garden City, N.Y.: Doubleday.
- Poppo, L., & Zenger, T. (2002). Do formal contracts and relational governance function as substitutes or complements? *Strategic Management Journal*, 23(8), 707-725.
- Porter, M. E. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*. New York: Free Press.
- Porter, M. E. (2001). Strategy and the Internet. *Harvard Business Review*, 79(3), 62-78.

- Porter, R. C. (2002). *The economics of waste*. Washington, DC: Resources for the Future.
- Portes, A., & Sensenbrenner, J. (1993). Embeddedness and Immigration - Notes on the Social Determinants of Economic-Action. *American Journal of Sociology*, 98(6), 1320-1350.
- Purcell, W. D. (Ed.). (1997). *Price Discovery in Concentrated Livestock Markets: Issues, Answers, Future Directions*. Blacksburg, Virginia: Research Institute on Livestock Pricing, Agricultural & Applied Economics, Virginia Tech.
- Quan, D. C. (2002). Market mechanism choice and real estate disposition: Search versus auction. *Real Estate Economics*, 30(3), 365-384.
- Rabinovich, E., Bailey, J. P., & Carter, C. R. (2003). A Transaction-Efficiency Analysis of an Internet Retailing Supply Chain in the Music CD Industry. *Decision Sciences*, 34(1), 131-172.
- Radicati Group, I. (2005). *Corporate Wireless E-mail Market, 2005-2009*. Palo Alto, CA: The Radicati Group, Inc.
- Ragin, C. C., & Becker, H. S. (1992). *What is a case? : exploring the foundations of social inquiry*. Cambridge [England] ; New York, NY, USA: Cambridge University Press.
- Rappa, M. (2004). *Business models on the web*. Retrieved 15 January, 2004, from <http://digitalenterprise.org/models/models.html>
- Reber, A. (1995). *Implicit Learning and Tacit Knowledge: An Essay on the Cognitive Unconscious*. New York: Oxford University Press.
- Resnick, P., Zeckhauser, R., Friedman, E., & Kuwabara, K. (2000). Reputation systems. *Communications of the ACM*, 43(12), 45-48.
- Rice, R. E., & Rogers, E. M. (1980). Reinvention in the innovation process. *Knowledge*, 1(4), 499-514.
- Richards, T. (1999). QSR NVivo (Version 2.0.163). Doncaster, Victoria, Australia: QSR International.
- Ring, P. S., & van de Ven, A. H. (1994). Developmental Processes of Cooperative Interorganizational Relationships. *Academy of Management Review*, 19(1), 90-118.
- Rivard, H., Froese, T., Waugh, L. M., El-Diraby, T., Mora, R., Torres, H., et al. (2004). Case Studies on the Use of Information Technology in the Canadian Construction

Industry. *Electronic Journal of Information Technology in Construction (ITcon)*, 9(2), 19-34.

Rogers, E. M. (1995). *Diffusion of innovations* (4th ed.). New York: Free Press.

Rosegger, G. (1986). *The economics of production and innovation : an industrial perspective* (2nd ed.). Oxford ; New York: Pergamon Press.

Ross, S. A., Westerfield, R., & Jaffe, J. F. (2005). *Corporate finance* (7th ed.). Boston: McGraw-Hill/Irwin.

Roy, C. (1998). Waste paper recycling vs. worldwide fiber market. *Fibroskopie: Recycling, Papierwirtschaft Und Weltweiter Zellstoffmarkt, Revue Forestiere Francaise*(3), 205-214.

Rudy, I. A. (1996). A critical review of research on electronic mail. *European Journal of Information Systems*, 4(4), 198-213.

Ryle, G. (1950). *The concept of mind*. New York,: Barnes & Noble.

Sahal, D. (1985). Technological guideposts and innovation avenues. *Research Policy*, 14, 61-82.

Samuels, M. (2001, 05-01-2001). Shakeout looms for online markets. *Computing*.

Sandulli, F. D. (2003). *The value of internet procurement to the firm: UCM-DMR Consulting E-Business Research Center - Complutense University of Madrid*.

Sanghera, B. (2004). *A Critique of Williamson's Transaction Cost*. Retrieved October 31, 2004, from http://uk.geocities.com/balihar_sanghera/mscthesiswilliamson.html

Sarkar, M., Butler, B., & Steinfield, C. (1998). Cybermediaries in electronic marketspace: Toward theory building. *Journal of Business Research*, 41(3), 215-221.

Sashi, C. M., & O'Leary, B. (2002). The role of Internet auctions in the expansion of B2B markets. *Industrial Marketing Management*, 31(2), 103-110.

Sawyer, S., Crowston, K., Wigand, R. T., & Allbritton, M. (2003). The social embeddedness of transactions: Evidence from the residential real-estate industry. *Information Society*, 19(2), 135-154.

Schlesinger, L. (2001, 09 Jan). What's happened to the B2B boom? *Accountancy Age*.

- Schroeder, T. C., Ward, C. E., Mintert, J., & Peel, D. S. (1997). *Beef Industry Price Discovery: A Look Ahead*. Blacksburg, VA: The Research Institute on Livestock Pricing, Virginia Tech University.
- Schultze, U., & Boland, R. J. (2000). Knowledge management technology and the reproduction of knowledge work practices. *Journal of Strategic Information Systems*, 9(2-3), 193-212.
- Schultze, U., & Moreau, P. (2000). *Electronic commerce: The impact of the internet on sales practices in the car industry*. Paper presented at the International Conference on Information Systems (ICIS), Brisbane, Australia.
- Schultze, U., & Orlikowski, W. J. (2004). A Practice Perspective on Technology-Mediated Network Relations: The Use of Internet-Based Self-Serve Technologies. *Information Systems Research*, 15(1), 87-106.
- Schumpeter, J. A. (1943). *Capitalism, socialism, and democracy*. London: George Allen and Unwin.
- Scott Morton, M. S. (1991). *The Corporation of the 1990s : information technology and organizational transformation*. New York: Oxford University Press.
- SEFEX. (2004). *SEFEX Brochure - About us*. Retrieved May 15, 2004, from <http://www.sefex.com/New-Customers/brochure/brochure.htm>
- Sewell, W. H. (1992). A Theory of Structure - Duality, Agency, and Transformation. *American Journal of Sociology*, 98(1), 1-29.
- Shapiro, S. P. (1987). The social control of impersonal trust. *The American Journal of Sociology*, 93(3), 623-658.
- Simon, H. A. (1955). A behavioral model of rational choice. *Quarterly Journal of Economics*, 69, 99-118.
- Smelser, N. J., & Swedberg, R. (1994). *The Handbook of economic sociology*. Princeton New York: Princeton University Press; Russell Sage Foundation.
- Smith, A. (1776). *An Inquiry into the Nature and Causes of the Wealth of Nations*.
- Smith, M. D. (2002). The impact of shopbots on electronic markets. *Journal of the Academy of Marketing Science*, 30(4), 446-454.
- Son, J.-Y., & Benbasat, I. (2004). *Organizational Adoption and Use of B2B Electronic Marketplaces: Efficiency- and Legitimacy-oriented Perspectives*. Vancouver, BC, Canada: Sauder School of Business, University of British Columbia.

- Souitaris, V., & Cohen, M. (2003). Internet-Business or Just Business?: Impact of 'Internet-Specific' Strategies on Venture Performance. *European Management Journal*, 21(4), 421-437.
- Speier, C., & Venkatesh, V. (2002). The hidden minefields in the adoption of sales force automation technologies. *Journal of Marketing*, 66(3), 98-111.
- Spulber, D. F. (1998). *Market microstructure: intermediaries and the theory of the firm*. Cambridge ; New York: Cambridge University Press.
- Steen, M. v. d. (2003, November 7-10). *Understanding the Evolution of National Systems of Innovation; a Theoretical Analysis of Institutional Change*. Paper presented at the EAEPE Conference, Maastricht, Netherlands.
- Steinfeld, C. (2004). The development of location based services in mobile commerce. In B. Preissl, H. Bouwman & C. Steinfeld (Eds.), *E-life after the dot.com bust* (pp. 177-197). Berlin: Springer.
- Steinfeld, C., Bouwman, H., & Adelaar, T. (2002). The dynamics of click-and-mortar electronic commerce: Opportunities and management strategies. *International Journal of Electronic Commerce*, 7(1), 93-119.
- Steinfeld, C., & Scupola-Hugger, A. (2005, March 8-9). *When Do SMEs Benefit from E-Commerce in an Industrial Cluster? Evidence from a Biotech Cluster*. Paper presented at the Asia Pacific Economic Cooperation (APEC) Symposium on Industrial Clustering, Taipei.
- Stigler, G. J. (1961). The Economics of Information. *Journal of Political Economy*, 69, 213-225.
- Stuckey, J., & White, D. (1993). When and When not to vertically integrate. *Sloan Management Review*, Spring, 71-83.
- Sykes, W. (1991). Taking stock: issues from the literature on validity and reliability in qualitative research. *Journal of the Market Research Society*, 33(1), 3.
- Tallroth, E. (2003, October 30 - November 2). *Centralized Trade, Decentralized Trade and Competition: Experiments and a Simulation*. Paper presented at the North American Meeting of the Economic Science Associations, Tucson, Arizona.
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533.

- Tether, B. S., & Hipp, C. (2002). Knowledge intensive, technical and other services: Patterns of competitiveness and innovation compared. *Technology Analysis & Strategic Management*, 14(2), 163-182.
- Thierry, M. C., Salomon, M., Van Nunen, J., & Van Wassenhove, L. (1995). Strategic Production and Operations Management Issues in Product Recovery Management. *California Management Review*, 37(2), 114-135.
- Thraen, C. (2003, April 23-24). *Milk and Dairy Product Price Risk Management in a Non-Federal Milk Market Order Environment: A Concept Paper*. Paper presented at the 10th Annual Workshop for Dairy Economists and Policy Analysts, Memphis, Tennessee.
- Timmers, P. (1998). Business Models for Electronic Markets. *Electronic Markets*, 8(2), 3-8.
- Trochim, W. M. K. (1989). Outcome Pattern-Matching and Program Theory. *Evaluation and Program Planning*, 12(4), 355-366.
- Tse, Y., & Zabolina, T. V. (2001). Transaction Costs and Market Quality: Open Outcry versus Electronic Trading. *Journal of Futures Markets*, 21(8), 713-735.
- Turban, E. (2004). *Electronic commerce 2004 : a managerial perspective*. Upper Saddle River, N.J.: Pearson/Prentice Hall.
- Turkington, J., & Walsh, D. (2000). Informed Traders and Their Market Preference: Empirical Evidence from Prices and Volumes of Options and Stock. *The Pacific-Basin Finance Journal*, 8(5), 559-585.
- Turner, D. (2005, October 12). Scrap steel futures make strong debut. *Financial Times*, p. 16.
- U.S.CensusBureau. (2004a). *2002 E-commerce Multi-sector Report*. Washington D.C.: U.S. Census Bureau.
- U.S.CensusBureau. (2004b). *NAICS 421930 Recyclable material wholesalers (2002 Economic Census, Wholesale Trade, Industry Series No. EC02-42I-19)*. Washington DC: U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau.
- U.S.CensusBureau. (2005). *Quarterly retail e-commerce sales 4th quarter 2004*. Washington D.C.: U.S. Census Bureau.
- USGS. (2003a). *Recycling - Metals (Minerals Yearbook)*. Reston, Virginia: U.S. Department of the Interior, U.S. Geological Survey (USGS).

- USGS. (2003b). *Recycling - Non-ferrous Metals* (Minerals Yearbook). Reston, Virginia: U.S. Department of the Interior, U.S. Geological Survey (USGS).
- Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. *American Sociological Review*, 61(4), 674-698.
- Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. *Administrative Science Quarterly*, 42(1), 35-67.
- Verhoest, P., Hawkins, R., Desruelle, P., Martinez, C., López-Bassols, V., Vickery, G., et al. (2003). *Electronic Business Networks: An assessment of the dynamics of business-to-business electronic commerce in eleven OECD countries. A Summary Report on the e-Commerce Business Impacts Project (EBIP)* (No. EUR No: EUR 20776 EN). Sevilla, Spain: Institute for Prospective Technological Studies.
- Vragov, R. (2005). *Implicit Consumer Collusion in Auctions on the Internet*. Paper presented at the 38th Hawaii International Conference on System Sciences, Waikoloa Village, Island of Hawaii.
- Wallis, J. J., & North, D. C. (1986). Measuring the Transaction Sector in the American Economy: 1870 to 1970. In S. L. Engerman & R. E. Gallman (Eds.), *Long Term Factors in American Economic Growth*. Chicago: University of Chicago Press.
- Walsham, G., & Han, C.-K. (1991). Structuration theory and information systems research. *Journal of Applied Systems Analysis*, 17, 77-85.
- Wang, R. (2000). Bidding and renegotiation in procurement auctions. *European Economic Review*, 44(8), 1577-1597.
- Wang, R. Q. (1993). Auctions Versus Posted-Price Selling. *American Economic Review*, 83(4), 838-851.
- Weber, J., Holmes, S., & Palmeri, C. (2005, November 7). "Mosh Pits" Of Creativity. *Business Week*.
- Webster, F. E., & Wind, Y. (1972). *Organizational buying behavior*. Englewood Cliffs, N.J.: Prentice-Hall.
- Weitzenfeld, J. S., Riedl, T. R., Chubb, C., & Freeman, J. (1993). Cross-domain language among expert software developers. *Metaphor and Symbolic Activity*, 7(3 & 4), 185-195. *Metaphor and Symbolic Activity*, 7(3 & 4), 185-195.

- Wigand, R., Steinfield, C., & Markus, M. L. (2005). IT Standards Choices and Industry Structure Outcomes: The Case of the United States Home Mortgage Industry. *Journal of Management Information Systems*, 22(2).
- Williams, T. (1997). Interorganisational Information Systems: issues affecting interorganisational cooperation. *Journal of Strategic Information Systems*, 6(3), 231-250.
- Williamson, O. E. (1975). *Markets and hierarchies: Analysis and antitrust implications*. New York: Free Press.
- Williamson, O. E. (1981). The economics of organizations: The transaction cost approach. *American Journal of Sociology*, 87(3), 548-577.
- Williamson, O. E. (1985). *The economic institutions of capitalism: firms, markets, relational contracting*. New York London: Free Press; Collier Macmillan.
- Williamson, O. E. (1991). Comparative Economic Organization: The Analysis of Discrete Structural Alternatives. *Administrative Science Quarterly*, 36(2), 269-296.
- Williamson, O. E. (2000). The new institutional economics: Taking stock, looking ahead. *Journal of Economic Literature*, 38(3), 595-613.
- Winter, S. G. (1986). The research program of the behavioral theory of the firm: orthodox critique and evolutionary perspective. In B. Gilad & S. Kaish (Eds.), *Handbook of behavioral economics* (pp. 2 v.). Greenwich, Conn.: JAI Press.
- Yin, R. K. (1993). *Applications of case study research*. Newbury Park, Calif.: SAGE Publications.
- Yin, R. K. (1994). *Case study research : design and methods* (2nd ed.). Thousand Oaks: Sage Publications.
- Yin, R. K. (2003). *Case study research : design and methods* (3rd ed.). Thousand Oaks, Calif.: Sage Publications.
- Zacharia, G., & Moukas, A. (2000). Collaborative reputation mechanisms for electronic marketplaces. *Decision Support Systems*, 29(4), 371.
- Zhu, K., & Kraemer, K. (2002). Electronic commerce metrics: Assessing the value of e-commerce to firm performance with data from the manufacturing sector. *Information Systems Research*, 13(3), 275-295.

- Zollo, M., Reuer, J. J., & Singh, H. (2002). Interorganizational routines and performance in strategic alliances. *Organization Science*, 13(6), 701-713.
- Zukin, S., & DiMaggio, P. (1990). *Structures of capital : the social organization of the economy*. Cambridge [England] ; New York: Cambridge University Press.

MICHIGAN STATE UNIVERSITY LIBRARIES



3 1293 02736 8962