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Research article

Exploring interorganizational systems at the industry level of analysis: evidence from the US home mortgage industry

Charles W Steinfield[1], M Lynne Markus[2], Rolf T Wigand[3]

[1]Department of Telecommunication, Information Studies, and Media, Michigan State University, East Lansing, USA
[2]Department of Management, Bentley College, Waltham, MA, USA
[3]Department of Information Science, University of Arkansas at Little Rock, Little Rock, AR, USA

Correspondence: CW Steinfield, Department of Telecommunication, Information Studies, and Media, Michigan State University, East Lansing, MI 48824-1212, USA.
Tel: +1 517 355 8372;
Fax: +1 571 355 1292;
E-mail: steinfie@msu.edu

Abstract
Interorganizational Systems (IOS) can have influences that extend beyond the organizations that implement them. Much can be learned at the industry-level of analysis that might not be revealed in studies conducted at the organizational level of analysis. This article summarizes a case study of one industry – the US home mortgage industry – in order to illustrate three types of industry-level phenomena that surface when examining use of interorganizational IT-driven coordination systems: collective actions among industry participants, performance effects, and structural effects. Our discussion of case results distinguishes between industry outcomes that are the net result of the accumulation of organizational actions *vs*. outcomes where industry-level consequences are qualitatively different from what is observed at the organizational level.
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Introduction

Developments in information and communication technologies have long been associated with changes in organizational form and function, including such changes as increased centralization, decentralization, productivity, competitiveness, skill changes, and a host of other organizational outcomes. In much of the early research about information technology (IT) effects on people and organizations, these systemic effects derived from the aggregated influences of the changing work patterns and production processes in specific organizational settings (Zuboff, 1988). However, as the deployment of IT for interorganizational coordination expands, it is likely that effects will extend beyond the confines of a single organization, influencing trading relationships, networks of organizations in a value chain, and even whole industries. Following common usage in the information systems literature, we refer to such systems as interorganizational systems (IOS). We define an interorganizational system as a complex package of software, interorganizational business processes, and infrastructures (including networks and standards). Our contention is that industry-level analysis is relevant to understanding the development, implementation and diffusion of an IOS.

In early studies of IOS, such as electronic data interchange (EDI) and computer-based reservation systems, researchers began to observe implications at the industry-level of analysis, pointing out how such systems alter the structure of markets in various ways by enabling increased outsourcing (Malone *et al*., 1987; Clemons and Row, 1988). These wider market-level influences extended beyond the simple creation of winners and losers in a given industry – they involved fundamental changes in the way particular industries operated. Yet, because of the cost and complexity of EDI, benefits often were more confined to a limited group of large organizations and may have contributed mostly to consolidation rather than to other types of structural changes (Wigand *et al*., 2005). Today, as electronic commerce permeates all industries, there is an even greater emphasis on the use of IT for interorganizational coordination. Moreover, the fact that emerging

electronic business standards are rooted in low-cost Internet technologies implies that coordination effects should extend to small and medium-sized enterprises (SMEs) (Gregor and Johnston, 2001; Markus *et al*., 2003b). Hence, the potential for industry-wide effects should be even greater.

Despite the general expectation that the introduction of IOS might have industry-wide effects, most research about organizations and IT has been conducted at the individual and organizational levels of analysis (Johnston and Gregor, 2000; Gregor and Johnston, 2001). Less common are studies that examine the implications of IT for larger aggregations of firms and especially investigations of IOS influences on entire industries.

Our contention in this paper is that much can be learned at the industry level of analysis that might not be revealed in studies conducted at the individual or organization levels of analysis. We use a case study of one industry – the US home mortgage industry – to illustrate the type of research issues and concerns that rise to the fore when examining IOS-related phenomena such as their design, implementation, usage, and effects (for more detail on this case, see Markus *et al*., 2003b; Wigand *et al*., 2005; Steinfield *et al*., forthcoming). We specifically focus on three industry-level phenomena: *collective actions* undertaken by industry members in order to enhance IOS development and diffusion, *performance effects* across the value chain in an industry, and industry-wide *structural effects*.

The paper is organized as follows. First, we introduce literature suggesting that some types of IOS phenomena are best examined at an industry level of analysis. We then introduce a case study of the US home mortgage industry, noting our research questions and methods. The third section outlines key findings regarding the uses and effects of IOS in this industry. Our final section discusses implications and conclusions of the research.

Review of literature

We structure our review along the lines of the three broad research foci mentioned above: the collective actions among industry participants that can shape the development, use and effects of IOS, the consequences of IOS for industry performance, and the potential industry structure effects of IOS. Our focus is on developing arguments about the industry as opposed to the organizational level of analysis.

Industry-wide collective action

Collective action is the coming together of independent organizations to develop, implement, or jointly adopt IOS (or IOS components such as standards). Frequently, new organizations are formed for this purpose, such as industry trade associations or standards making consortia. However, it is not appropriate to regard collective action as an organization-level phenomenon, because the members of the collective retain their separate identities. The behavior of the collective is an emergent outcome of organization-level behavior, thus properly considered an industry-level phenomenon.

The anticipation of wide-scale, industry-level effects brought on by IT innovations are often tied to the relative costs and ease of implementation of the technology in question. Experience with EDI did not result in seamless integration across the value chain because most small organizations did not adopt the technology and many large organizations constructed unique pair-wise agreements (Computer Business Review Online, 2001; Songini, 2001). The availability of Internet technology encouraged many industry leaders to try again for seamless interconnection, using XML-based standards. Prior research suggests that industry-wide performance advantages resulting from the use of IT-based interorganizational coordination may depend on the development of transaction standards (Gregor and Johnston, 2001; Songini, 2001; Jain and Zhao, 2003; Markus *et al*., 2003b).

The development of standards for IOS is by definition an activity that cannot be studied solely at the organizational level of analysis. Industry-wide standards (as opposed to 'company standards') are not likely to emerge out of normal repeated interaction and they are not likely to emerge when, for example, there are non-interacting 'supply chains' or when they are blocked by powerful players. When they do occur, they will require collective action, usually spearheaded by an industry group of some sort (Astley and Fombrun, 1983). As collective actions, standards development and adoption are sensitive to the many kinds of social dilemmas that arise when competing entities need to cooperate in creating a public good (Olson, 1965; Kollock, 1998). Competing organizations must cooperate to develop standards that address the needs of all segments within the industry to increase the likelihood that they will be adopted. Industry-level collective behavior, especially within the context of standards setting, thus becomes relevant to the question of what we learn when examining IT usage and effects at higher levels of analysis.

Technological innovation can be viewed as an external influence that creates the conditions for an otherwise uncoordinated set of organizations to act as an industry collective (Gregor and Johnston, 2001). Many industries have formed associations specifically to address the new opportunities offered by XML and the Internet to achieve vertical (or industry-specific) information system (VIS) standards that can support electronic commerce across the supply chain (Markus *et al*., 2003b; Wigand *et al*., 2005, Steinfield *et al*., forthcoming). These are generally user-led, rather than vendor-led initiatives and are not likely to be adopted unless they meet the needs of users (Hills, 2000). Since users of VIS standards are organizations that do business with each other and these organizations are of different kinds (e.g., manufacturers and retailers, hospitals and insurance companies), no one user is in a position to design a standard that would meet the needs of all users. Consequently, a voluntary association of industry participants using a consensus-based approach is most likely to succeed in developing an approach to interorganizational coordination that many industry participants would be willing to adopt. Prior studies of such voluntary, user-led associations suggest the importance for success of what the association does to structure collaboration among participants to the standards-setting effort, to facilitate standards adoption, and to prepare for ongoing maintenance (Brown, 1997; van Baalen *et al*., 2000; Steinfield *et al*., forthcoming).

Performance effects

Performance effects are changes in the performance metrics associated with interorganizational business processes (processes that cut across various participants in an industry). For example, the mortgage industry process 'application to close' involves the consumer, the broker, credit agencies, lenders, insurers, appraisers, escrow companies, etc. The process metric of process cycle time is a function of the performance of multiple industry players.

IOS use can have dramatic influences on industry performance. At a simple level, overall industry profitability or competitiveness can be seen as an outcome of increased individual organization profitability or competition intensity (at least within a specific industry segment). In this view, IT innovations influence individual organizations' relative costs and profitability of producing products and services, coordinating with other organizations, and developing new types of products and services. At the industry level, then, we would expect these organization-level effects to accumulate following broad improvements in industry-level efficiency.

Such aggregate effects have long been attributed to the widespread use of IOS in many industries throughout the history of IT development. The implementation of bar codes and bar code readers, for example, transformed inventory stocking and replenishment practices throughout the retail industry (Brown, 1997), just as the advent of multiple listing services influenced the ability of real estate brokers to more efficiently match clients with available homes (Crowston *et al*., 2001). When an IOS is built on standards-based technologies, such as Internet protocols, widespread adoption and usage can make many products and services available that were heretofore too costly or too cumbersome to produce.

In other cases, changes in industry practice resulting from organization-level cost reductions lead to qualitatively different types of outcomes. For example, the emergence of artist-led music distribution, for example, represents such a new approach based on an Internet-based IOS (Clemons and Lang, 2003; Bockstedt *et al*., 2005).

Consequences for industry structure

Structural effects are changes in industry structure that can be attributed in part to IOS and intraorganizational IT uses. Examples include consolidation, vertical integration, vertical dis-integration, and new organizational forms.

Although less common than organization-level studies, there are a number of instances where researchers have examined the consequences of IT using an industry level of analysis (Hess and Kemerer, 1994; Segars and Grover, 1995; Gregor and Johnston, 2001; Simons, 2001; Jacobides, 2004). Often, these studies emphasize how the use of IT for coordination across organizations influences the structural features of an industry, such as the dis-integration of organizational processes (Argyres, 1999). For example, Segars and Grover (1995) looked for broad IT effects in three oft-studied industries: (1) airlines and computer-based reservation technology, (2) industrial chemicals and EDI, and (3) drug wholesaling and EDI. Their analysis revealed that the IT initiatives altered the structural characteristics of each industry, as strategic IT innovations by one member of a strategic group were imitated by others. One factor that helped shape the structural effects was the degree to which the innovation was easily imitated and implemented by competitors, as has been pointed out by others who examined the early use of electronic order entry systems in the drug wholesale industry (Clemons and Row, 1988). In another study of IOS and industry structure, Simons (2001) questioned whether the UK IT consulting industry had been altered by the growing use of the Internet. Inspired by theories about the disruptive nature of technologies – whereupon established organizations lose their competitive positions in an industry when they fail to adopt technologies that alter the bases of competition (Tushman and Anderson, 1986; Christensen, 1997), Simons (2001) looked over three decades to see if the Internet altered entry, exit, growth, and business areas of new entrants and incumbents. Findings did not support a disruptive impact as of 2000, suggesting that by itself, the Internet had not altered industry structure.[1]

Many other studies have explored the effects of IT on market structures, often by extension from a small number of case studies of individual organizations (Malone *et al*., 1987; Clemons and Row, 1988; Hess and Kemerer, 1994). On the one hand, greater consolidation is predicted because IT enables greater scale economies, favoring larger organizations (Clemons and Row, 1988). However, as more standards-based IT emerges and is applied to interorganizational transactions, transaction cost theorists anticipate increases in outsourcing and perhaps more opportunities for smaller organizations (Malone *et al*., 1987; Brynjolfsson *et al*., 1994). An emphasis on proprietary systems, in fact, might hold back the 'move to the market,' encouraging organizations to deal with smaller numbers of trading partners in order to ensure adequate return on investments made to support transactions with a given supplier or buyer (Clemons *et al*., 1993; Mukhopadhyay *et al*., 1995; Steinfield *et al*., 1995; Kraut *et al*., 1999). Other research has explored additional industry-level influences of IT beyond consolidation and outsourcing, such as the potential for bypassing intermediaries (Sarkar *et al*., 1995; Wigand and Benjamin, 1995). The only way to ascertain a complete picture of these developments and to observe these kinds of structural changes over time is to take an industry-wide view.

This brief review provides a rationale for taking an industry-level perspective when attempting to understand the development, adoption and potential consequences of using IOS such as those supporting business-to-business electronic commerce. Although individual organizations engage in purposive, goal-oriented behavior when adopting and using IOS, the accumulated effects of these participants' actions will have implications for the industry as a whole in terms of supply chain efficiencies and industry structure changes (Gregor and Johnston, 2001).

Mortgage industry case

We now explore the three industry-level phenomena associated with IOS within the context of a case study of the US home mortgage industry. Evidence to support our analysis comes from three sources: in-depth interviews, direct observation in standardization meetings, and

documents. A major source of information was the mortgage industry's primary industry association, the Mortgage Bankers Association of America[2] (http://www.mbaa.org, often referred to as the MBA). Key informants at the MBA helped identify potential interviewees who were well placed to comment on the industry's standardization organization, known as Mortgage Industry Standards Maintenance Organization (MISMO). MISMO's website (http://www.mismo.org) and other documentary sources provided valuable background material. In addition, we observed and conducted interviews at two industry meetings: the Mortgage Technology Conference in Orlando, FL, USA (March 2003) and the MISMO Trimester Workgroup Meeting in Dana Point, CA, USA (January 2004).

In all, we conducted formal interviews with three people from the MBAA (one several times) six additional people active in MISMO who represented other areas in the mortgage value chain including a government sponsored enterprise (GSE), a mortgage information and document services provider, a mortgage insurer, a mortgage credit reporting company, and two mortgage IT vendors, three people in the Data Interchange Standards Association (DISA – a support organization for standards organizations like MISMO), five mortgage industry executives, and numerous informal interviews at industry meetings.

Additional data came from archival sources such as MISMO's website and members-only discussion databases and articles in Mortgage Banking and Mortgage Technology – both MBA publications. Among other document analyses, we reviewed and coded 25 years of articles related to IT, EDI, and standards in the industry. This material substantially increased our understanding of the key historical events and the concerns of industry participants. Interviews were taped and transcribed to facilitate our review and analysis. We hand-coded our interview transcripts for key theoretical themes, documenting our evolving understanding of key issues in numerous theoretical memos. We elaborated our growing understanding through weekly conference calls and periodic face-to-face meetings over the three years we have worked on this project. Versions of our case analysis have been reviewed for factual accuracy by interviewees and other industry experts.

The mortgage industry offers a particularly good venue for exploring industry-level influences of IOS. It is a highly fragmented industry, often characterized in the past as inefficient (Markus *et al*., 2003b). There are essentially two broad segments in the home mortgage industry in the United States: a primary market where consumers obtain loans from lenders, and a secondary market where mortgage loans are packaged and sold to investors (Cummings and DiPasquale, 1997). The primary market is the more fragmented: it includes thousands of mortgage brokers, lenders, loan servicers, credit agencies, appraisers, title companies, escrow companies, and mortgage insurance providers. The key processes in this market include origination (including application for a loan, assessing applicants' credit worthiness, and property appraisal), closing and recording (the legal transfer of title to the property), and servicing (involving the collection of loan payments, management of escrow and tax obligations, dealing with foreclosures, and making payments to investors) (Cummings and DiPasquale, 1997). The key processes in the secondary market include the selling of the loan directly to investors, or to one of the GSEs such as the Federal National Mortgage Association (Fannie Mae) or the Federal Home Mortgage Corporation (Freddie Mac), that in turn package and securitize loans and sell interests in these securities to investors. The secondary mortgage market is quite concentrated in the US. In 2003, roughly 50% of the $6.3 trillion in outstanding US mortgage debt for single-family residences was held in portfolio by the GSEs or by investors in the form of mortgage-backed securities guaranteed by the GSEs (Cummings and DiPasquale, 1997).

MISMO as a forum for collective action in the mortgage industry

In our review, we suggested that industry-wide IT initiatives depend on standards and hence the collective action of industry participants. We noted that earlier EDI-based IOS standards faltered due to high cost, complexity, and lack of adoption especially by the larger numbers of SMEs in many industries. However, with the growing popularity of the Internet and XML, many industries are, in fact, organizing consortia to create new lower cost standards for electronic exchanges (Markus *et al*., 2003b; Wigand *et al*., 2005; Steinfield *et al*., forthcoming). The mortgage industry is no exception, even with the widespread adoption of automated underwriting, there remain continuing opportunities for greater efficiencies based on usage of standards-based IOS (Mortgage Technology, 2005).

Interviewees in our case study discussed a number of opportunities for improved efficiency in interorganizational transactions. These opportunities illustrate the potential that standards-based IOS hold for improved industry-level efficiency. They include:

- *Rekeying*: Some mortgage lenders manually key-enter basic mortgage application data, and across the many companies involved from origination to closing, the same data can be rekeyed as many as seven times due to unintegrated back office systems.
- *Forms proliferation*: In part because of differences in state and local regulations, as many as 30,000 different proprietary forms are used in the industry today.
- *Lost documents*: One interviewee described a major mortgage bank with a Lost Mortgage Department with over 200 employees. Electronic mortgage documents are less likely to get lost, especially as they move across the value chain in the industry from origination to closing and subsequently to the secondary market.
- *Customer frustration*: Taking out or refinancing a mortgage loan can take months. As a result of the many involved parties, customers often do not know what their final closing costs will be until the date of closing or later, resulting in lenders coping with uncertainties by initially overcharging and then refunding the balance.
- *Post-closing process problems*: A considerable cost of mortgage lending is the post-closing correction of errors generated during the origination process (e.g., missing documents and signatures).
- *Secondary market processes*: Mortgages are frequently resold after closing, and mortgage servicing is often managed by parties other than the original lender – transfer processes that offer many opportunities for errors.

In January 2000, the MBA, in partnership with Fannie Mae, Freddie Mac and other industry participants, launched MISMO (see http://www.mismo.org), which was established to coordinate the development and maintenance of vendor-neutral XML-based transaction specifications to support data sharing among the many participants in the mortgage-lending processes. MISMO's early efforts were focused on building a comprehensive data dictionary, clarifying the meaning and representation of terms relevant for the various transactions in the mortgage industry. The MISMO data dictionary has over 3400 terms (Wigand *et al*., 2005). A second related effort involves the specification of transaction standards necessary to support fully electronic mortgages – all along the value chain from origination to closing and registering with country recorders and on to sales in the secondary market and transfer of servicing rights (Wigand *et al*., 2005).

MISMO efforts can easily be viewed through the lens of collective action. A group of organizations must cooperate to achieve the development of VIS standards. Organizations have varying interests in participating and varying resources to contribute to the process. Organizations that do not contribute to development cannot be excluded from adopting and benefiting from the standards once they are implemented in software. Indeed, for the effort to be a success, standards developers want as many industry participants as possible to adopt standards-based software, whether they contributed to standards making or not.

In our case study of MISMO, we observed a number of strategies used by the organization to improve the likelihood of widespread adoption. These strategies are briefly highlighted here and described in detail in Steinfield *et al*. (forthcoming).

First, efforts were made to increase involvement by large- and small-industry participants from all segments of the mortgage industry. Membership was open, and any interested company was invited to join MISMO. Costs of participation were kept to a minimum, and where possible, low-cost teleconferencing solutions were used to enable participation. Extra efforts to bring in the GSEs to the standardization process were made, given that nearly all lenders and most other mortgage industry participants worked with them either directly or indirectly.

Second, MISMO participants made great efforts to avoid allowing competitive pressures derail the standards-making process, mainly by limiting the scope of the standards-making effort. The decision was taken early on to emphasize only the interorganizational aspects of transactions and not to get into the business of defining what happens inside any mortgage industry company. MISMO's decision to develop a data dictionary first avoided many conflicts that might otherwise arise if the organization attempted to pick winners out of particular ways of completing transactions.

Third, MISMO paid careful attention to governance processes that would not be perceived as favoring any one player or industry segment over another. Participants can join the workgroup of their choice and participate in all activities except the leadership positions, which are filled in annual elections held by subscriber organizations. Workgroups are required to follow published agendas, and they are encouraged to seek consensus and operate fairly through a clearly stated code of conduct. Data standards were selected for work based on interest expressed by meeting participants. A governance committee was created representing all segments of the industry; it is elected by the full membership.

Finally, MISMO has worked actively to defend the standards against fragmentation (Damsgaard and Truex, 2000), through the development of a compliance testing regime, and against legal challenges, through the implementation of an intellectual property rights policy. In this policy, all members must first sign an agreement to provide to MISMO free of charge any intellectual property to be included in the standards (including derivative rights), before they are allowed to participate in standard setting work groups. MISMO also recognizes that the development of IT standards is an ongoing process, and, in the January 2004 MISMO meetings, plans were unveiled for setting up a permanent 501(c)(6) organization as a wholly owned subsidiary of the MBA (Steinfield *et al*., forthcoming).

In summary, in order to maximize the benefit from IOS, the mortgage industry engaged in a collective effort to develop vertical IS standards. Viewing this effort as a collective action and studying the strategies used to avoid common social dilemmas associated with collective goods proved to be a fruitful way to understand these processes. Moreover, the problems extend beyond the production of the standard: Vertical IS standards are of little value if they are not adopted by industry participants. Hence, efforts have to be taken during the development stage to produce standards that will be adopted, even by those companies that did not participate in the voluntary standards association.

Interorganizational IT systems and mortgage industry performance

The mortgage industry has been viewed as a relatively late adopter of IOS. Until the 1990s the mortgage process was largely manual and decentralized, with thousands of underwriters employed by the many lenders engaged in a largely subjective review of credit reports to make loan decisions (Straka, 2000). Impetus for change came from an empirical study completed by Freddie Mac in 1992, showing the value of credit scores for predicting mortgage default (Straka, 2000). This led to the rapid growth of what is arguably the most important type of IOS in the mortgage industry – automated underwriting (AU) systems. In 1994, Freddie Mac deployed a pilot version of its AU system, called Loan Prospector, which used statistical mortgage scoring. Shortly thereafter, Fannie Mae introduced a similar system called Desktop Originator. Although introduced by single organizations, AU systems are good examples of IOS. They must be implemented across multiple participants – for example, brokers, banks, and GSEs – and structured data flows between these value chain participants allow for decisions on mortgage approvals to be made rapidly.

Since about 1998, AU adoption has been rapid: By 2001, AU adoption by mortgage bankers was reported at 98% (Punishill, 2001); 58% of mortgage bankers used one of the GSE's AU systems as opposed to an in-house system or one from an independent vendor (Kersnar, 2001). The GSEs have continued to expand their technology offerings. Today, they offer IT-based support for secondary

marketing, servicing, and integration with business partners, in addition to their core AU technology. In addition, they have continued to expand the scope of the AU technology (historically confined to conforming loans) to all residential mortgage loans, and they have gradually extended access to AU technology (historically confined to mortgage bankers) to other industry players such as mortgage brokers and real estate agencies.

The effects of AU on mortgage industry performance have been major and continue to unfold (Jacobides, 2001b). Before AU, borrowers could wait weeks for an approval decision from lenders, because the lenders often had to wait weeks to get an 'accept' decision from one of the GSEs (in essence, a guarantee that the GSE would purchase the closed loan, an important consideration to many mortgage bankers who did not plan to keep the loan in portfolio). Today, lenders and borrowers can get these approval decisions within minutes. The Mortgage Bankers Association of America (MBA) estimates that the cost of originating a loan has decreased by 50% in the ten years since AU came online (MBA, personal communication 1/28/2003) – probably because the need for human underwriters in mortgage banks decreased sharply. AU-enabled credit scoring is said to have markedly improved the accuracy of underwriting decisions, reducing mortgage default rates despite a declining economy. It has also concentrated enormous volumes of data in the hands of the GSEs (FannieMae's database holds data on about one-third of all US homes and one-fourth of all US home buyers, (Posner and Courtian, 2000)). This process is expected to provide AU users with new sources of potential revenue and competitive advantage, such as the ability to 'personalize pricing' (Punishill, 2001), i.e., to price loans on the basis of prepayment risk, not just credit risk (Van Order, 2000). As a result of these developments, experts expect sizable *additional* reductions in the cost of loan origination over the next few years (Posner and Courtian, 2000).

The evidence is mounting that widespread use of IOS (i.e., AU systems) in the mortgage industry has led to significant improvements in industry performance. Industry experts point, for example, to the industry's ability to handle the dramatic boom in refinancing applications during the previous few years as a sign that AU and other IT applications had improved overall efficiency (Peterson, 2004). Peterson (2004) notes that the mortgage industry handled three times the loan volume in the boom period between 2001 and 2003 as it did during the last pre-AU boom of the early 1990s.

More recent efforts to introduce standards into mortgage industry IOS have been associated with even greater efficiencies in the industry. A study conducted for the MBA found that users of the new MISMO data standards saved $249 on a loan, with 75% of the savings going directly to the lenders (Mortgage Technology, 2005). Study participants all saw significant potential related to increasing use of standards-based IOS. The study authors estimated that loan processing time could be reduced by 16%, and more than three-fourths of the study participants believed that use of the standards would lower overall costs, reduce data entry and rekeying costs, and improve data accuracy (Mortgage Technology, 2005). Moreover, the two primary providers of AU services recently promised to endorse MISMO standards, giving a powerful stimulus to the adoption of both the standards and standards-based IOS.

Despite these actual and potential gains, it is clear that standards development is not sufficient: efforts must be made to encourage standards implementation and diffusion. There is clearly room for improvement in this regard, as only 40% of the MBA study respondents are currently using MISMO standards (Mortgage Technology, 2005).

Greater use of the Internet has also influenced other aspects of the industry's ability to serve customers. Today, the increased use of online loan origination has enabled buyers to seek loans from lenders outside their local market, and loan comparison services such as offered by LendingTree.com reduce buyer search costs (Clemons and Hitt, 2000; Markus *et al*., 2003a). It also appears that online origination, which accounted for as much as 4% of all mortgages in 2002, also helped lenders cope with the demand for refinancing, as these loans accounted for more than 75% of the online business (Insurance Information Institute, 2005).

In summary, our case analysis of the mortgage industry suggests that widespread use of IOS yields industry-wide performance improvements over and above those visible at the organizational level of analysis.

Interorganizational IT systems and mortgage industry structure

Our review of the literature regarding the potential industry structure consequences of IOS yielded mixed expectations: Some authors argued that greater use of IOS would result in consolidation as the largest organizations capitalized on scale economies, while others predicted more vertical disintegration and increased use of outsourcing. Our case analysis of the mortgage industry reveals that both kinds of structural influences may occur simultaneously.

The mortgage industry has undergone considerable consolidation in the past decade – changes attributed by many experts to IT (Jacobides, 2001b). Since 1992, 17 of the 25 largest residential lenders in the mortgage industry have disappeared from the market (Duncan, 2003). Today, the top five lenders provide over 50% of loans, while the top 10 mortgage services control more than 50% of this segment (Markus *et al*., 2003b). This trend predates the availability of MISMO standards, however. Small organizations continue to prosper in niche markets. Furthermore, it is not just the larger organizations that are enabled by standards to grow, as evidenced in the following quote from one of our interviewees: 'Over the past six or seven years, [my company] has gone from a nobody in the industry to [a leading player]. On the disadvantage side, because of the growth and use of standards that helped [my company] grow, it also helped a lot of smaller [companies] establish themselves by using those standards. Because anytime you set or establish a data standard, what is being put out there is not just data formats, there's a lot of industry knowledge that goes into those data standards.'

Hence, at the same time that consolidation is occurring among the largest players, there is evidence of increased reliance on more efficient, specialized players, driven by the reduced coordination costs afforded by vertical IS standards (Jacobides, 2004). For example, Jacobides (2004) described several episodes of vertical dis-integration of the mortgage industry value chain prior to 1994 – the

separation of mortgage brokering from mortgage banks, the separation of loan provision from the secondary investment market, and the separation of mortgage origination from mortgage servicing – and attributed them in part to the use of standardized coordination mechanisms such as AU and credit scoring.

Standards-based IOS appear to promote outsourcing by eliminating lock-in effects caused by proprietary technology. One interviewee observed: '[When there are] seven or eight companies out there using the standard, if one company starts providing poor service, it makes it easy for [their customers] to switch to a different company who is using the same standard. Whereas when they're on proprietary standards, they're locked into the company that they're doing business with.'

In a series of papers exploring mortgage industry structural change over the decade leading up to 1994, Jacobides and colleagues linked fundamental changes in the mortgage industry to innovations in IT (Jacobides, 2000, 2001a, b, 2004; Jacobides and Hitt, 2001). They focused on such IT innovations as AU and credit scoring applied in computerized loan origination systems to try to explain a decade long process of vertical dis-integration in the industry. In their view, the mortgage industry shifted from fully integrated mortgage banks (in which banks handled both loan origination and servicing – collecting the monthly payments from mortgage recipients – and kept the mortgage loans in portfolio) to an unbundled value chain in which separate, specialized companies perform these functions. More standard ways of moving mortgage data across company boundaries helped in this process, allowing companies to specialize and build economies of scale in specific stages of the mortgage process.

What seems to be emerging is a two-tier structure of a few very large and growing organizations and many small organizations, but few organizations of intermediate size (Forrester, 2001). This evidence suggests that industry-level structural changes resulting from the introduction of low-cost standards-based IOS differ qualitatively from simple consolidation favoring large organizations.

In summary, our case analysis suggests that the widespread use of an industry IOS can result in greater consolidation, but overall industry structure consequences are likely more textured than this, especially as the IOS becomes more standards-based. Larger organizations are likely to continue to grow as they reap the scale benefits arising from enhanced efficiency. However, reduced lock-in and advantages from specialization also appear to lead to increased dis-integration and use of outsourcing that create greater opportunities for smaller and more niche-oriented players. In that sense, such standardization efforts have resulted in an equalizing function from which all firms, small, medium and large, in the industry can benefit.

Discussion and conclusions

Our case study of the US mortgage industry clearly supports our contention that much can be learned when exploring IOS from an industry perspective. We begin our discussion of this case by suggesting that it illustrates the need to take a 'multilevel' perspective (Klein and Kozlowski, 2000) in order to explain how the dynamics and interactions among lower-level elements (people and organizations) unfold over time to yield structure or collective phenomena at higher levels (industries). Such an approach helps reveal how IOS can give rise to qualitatively different industry-level patterns and outcomes, rather than outcomes than can be easily interpolated from organization-level data.

Multilevel perspectives offer a useful way to consider industry-level phenomena arising from widespread use of IOS. They help to distinguish what Klein and Kozlowski (2000) refer to as composition *vs.* compilation types of collective effects. Composition effects result from the accumulation of lower-level properties without any qualitative differences at the higher levels of analysis. Klein and Kozlowski use the example of organizational climate, which emerges from employees' shared perceptions, as one instance of a compositional effect. The collective outcome is essentially equivalent to the sum of the individual-level phenomena. On the other hand, compilation effects are those in which the higher-level outcome is the result of some discontinuity, or change, that occurs across levels. The whole is greater than – or least different from – the sum of the parts. Klein and Kozlowski use the example of team performance to illustrate a compilation effect: The synergies emerging from the mix of individuals' skills and backgrounds are not a simple sum of the parts.

An industry perspective encourages a focus on the collective behavior of industry participants, particularly as they engage in the development of standards for industry IOS. This focus paid dividends in our mortgage industry case by revealing approaches to countering common dilemmas involved in the production of public goods. Moreover, the case provided new insights for collective action theory, as this theory normally does not consider what happens after the production of the collective good. In the case of standards, development is merely the first stage, and, without later adoption even by non-participants, there will be little benefit to the industry as a whole.

Our case also revealed that in addition to consequences for the performance of individual organizations, widespread use of IOS across an industry can have major implications for industry collective actions, industry efficiency and industry effectiveness. Without widespread usage, an IOS might improve one organization's performance but raise costs for others, and individual consumers may see little benefit. In the case of AU, which became a pervasive IOS in the mortgage industry, overall performance gains were quite remarkable and clearly evident to home buyers seeking mortgages even though many different companies are involved in the chain from origination to closing and servicing.

The industry perspective also is sensitive to more refined notions of structural change accompanying widespread use of IOS than are organization-level perspectives. A multilevel perspective helps to understand IOS consequences for industry structure. Simple concentration appears to be a compositional effect arising from economies of scale gained through the use of an IOS. On the other hand, industry structure changes such as vertical integration or dis-integration appear to be the results of compilation processes. We found both types of consequences in the mortgage industry case. Our finding of both greater

consolidation at the top of the mortgage industry, accompanied by more specialization and vertical disintegration among smaller participants would not have been visible at the organizational level of analysis.

An important methodological lesson of this study for future research is the importance of incorporating a case-based approach. Case-based research is likely to be needed in any cross-industry comparative analysis, because, compared to organizations, there are far fewer industry groups, making it harder to obtain samples sufficient for survey and quantitative analysis. In addition, case-based research is essential for 'process tracing' – identifying the dynamics by which organization-level interactions emerge into industry-level outcomes.

There is clearly a need to extend this work, given the limitations of a single case. It should be extended across time within the mortgage industry to see if the efforts taken to encourage widespread usage of standards-based IOS are successful. Researchers also need to explore similar phenomena across industries to explore how such factors as existing industry structure, the nature of products and services, and alternative practices regarding IOS standardization influence industry-level outcomes.

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Notes

1 We do not mean to suggest that the Internet has not had a disruptive effect in any industry. Clearly such innovative uses of the Internet as voice over Internet protocol (VoIP), and music and movie downloading raise considerable potential for reshaping the structure of these communications industries.

2 Founded in 1914, the MBA is the leading industry association for companies in the real estate finance business, the largest segment of the US capital market. Its approximately 2800 members cover all industry segments, including mortgage lenders, mortgage brokers, thrifts, insurance companies, etc. The MBA represents the industry's legislative and regulatory interests and conducts educational activities and research for its members.

References

Argyres, N.S. (1999). The Impact of the Information Technology on Coordination: Evidence from the B-2 'Stealth' bomber, *Organizational Science* **10**(2): 162–180.

Astley, W.G. and Fombrun, C.J. (1983). Collective Strategy: Social ecology of organizational environments, *Academy of Management Review* **8**(4): 576–587.

Bockstedt, J., Kauffman, R.J. and Riggins, F.J. (2005). The Move to Artist-led Online Music Distribution: Explaining structural changes in the digital music market, Paper presented at the 38th Hawaii International Conference on Systems Sciences (Kona, Hawaii, 2005).

Brown, S.A. (1997). *Revolution at the Checkout Counter: The Explosion of the Bar Code*, Cambridge, MA: Harvard University Press.

Brynjolfsson, E., Malone, T.W., Gurbaxani, V. and Kambil, A. (1994). Does Information Technology Lead to Smaller Firms? *Management Science* **40**(12): 1628–1644.

Christensen, C.M. (1997). *The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail*, Boston: Harvard Business School Press.

Clemons, E. and Hitt, L. (2000). The Internet and the Future of Financial Services: Transparency, differential pricing and disintermediation (No. 00-35), Philadelphia: University of Pennsylvania, The Wharton Financial Institutions Center.

Clemons, E. and Lang, K.R. (2003). The Decoupling of Value Creation from Revenue: A strategic analysis of the markets for pure information goods, *Information Technology and Management* **4**: 259–287.

Clemons, E., Reddi, S. and Rowe, M. (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.

Clemons, E. and Row, M. (1988). McKesson Drug Company: A case study of Economost – a strategic information system, *Journal of Management Information Systems* **5**(1): 36–50.

Computer Business Review Online (2001). XML for the World, *Computer Business Review Online*, [WWW document] http://www.cbronline.com/content/comp/magazine/articles/archive/000574.asp (accessed 1 September 2005).

Crowston, K., Sawyer, S. and Wigand, R. (2001). Investigating the Interplay between Structure and Information and Communications Technology in the Real Estate Industry, *Information Technology and People* **14**(2): 163–183.

Cummings, J. and DiPasquale, D. (1997). *A Primer on the Secondary Mortgage Market*, Boston, MA: City Research.

Damsgaard, J. and Truex, D. (2000). Binary Trading Relations and the Limits of EDI Standards: The Procrustean bed of standards, *European Journal of Information Systems* **9**(3): 142–158.

Duncan, D.G. (2003). MISMO Evolution, *Mortgage Banking – The Magazine of Real Estate Finance, December* **46–50**: 52.

Forrester (2001). *Mach 2001: Mortgage Lenders Get Squeezed*, Cambridge, MA: Forrester.

Gregor, S. and Johnston, R. (2001). Theory of Inter-Organizational Systems: Industry structure and processes of change, Paper presented at the 34th Hawai'i International Conference on Systems Sciences (Maui, January 3–62001).

Hess, C.M. and Kemerer, C.F. (1994). Computerized Loan Origination Systems: An industry case study of the electronic markets hypothesis, *MIS Quarterly* **18**(3): 251–275.

Hills, B. (2000). Common Message Standards for Electronic Commerce in Wholesale Financial Markets, *Bank of England Quarterly Bulletin* **40**(3): 274–285.

Insurance Information Institute (2005). *The Financial Services Factbook 2005*, New York: Insurance Information Institute.

Jacobides, M.G. (2000). *Capabilities, Transaction Costs, Information Technology and Profitability in the Un-Bundling Mortgage Banking Value Chain: A Study of the Drivers and Implications of Changing Vertical Scope*, Philadelphia, PA: Unpublished Doctoral dissertation, University of Pennsylvania.

Jacobides, M.G. (2001a). Mortgage Banking Unbundling: Structure, automation and profit, *Mortgage Banking* **61**(4): 28–40.

Jacobides, M.G. (2001b). Technology with a Vengeance: The new economics of mortgaging, *Mortgage Banking* **62**(1): 118–131.

Jacobides, M.G. (2004). Industry Change through Vertical Dis-Integration: How and why markets emerged in mortgage banking, *Academy of Management Journal* **48**(3): 465–499.

Jacobides, M.G. and Hitt, L.M. (2001). Vertical Scope, Revisited: Transaction costs *vs* capabilities & profit opportunities in mortgage banking, Working Paper #01–17, Wharton Financial Institutions Center, The Wharton School, April.

Jain, H. and Zhao, H. (2003). A Conceptual Model for Comparative Analysis of Standardization of Vertical Industry Languages, Paper presented at the Proceedings of the Workshop on Standard Making: A Critical Research Frontier for Information Systems (Seattle, WA, December 12–14, 2003).

Johnston, R. and Gregor, S. (2000). A Theory of Industry-Level Activity for Understanding the Adoption of Interorganizational Systems, *European Journal of Information Systems* **9**: 243–251.

Kersnar, S. (2001). Who Gains from Fannie's and Freddie's Internet, *Mortgage Technology* **8**(7): 18–23.

Klein, K.J. and Kozlowski, S.W.J. (eds.) (2000). *Multilevel Theory, Research, and Methods in Organizations: Foundations, Extensions, and New Directions*, San Franciso: Jossey Bass.

Kollock, P. (1998). Social Dilemmas: The anatomy of cooperation, *Annual Review of Sociology* **24**: 183–214.

Kraut, R., Steinfield, C., Chan, A., Butler, B. and Hoag, A. (1999). Coordination and Virtualization: The role of electronic networks and personal relationships, *Organization Science* **10**(6): 722–740.

Malone, T., Yates, J. and Benjamin, R. (1987). Electronic Markets and Electronic Hierarchies: Effects of information technology on market structure and corporate strategies, *Communications of the ACM* **30**(6): 484–497.

Markus, M.L., Steinfield, C. and Wigand, R. (2003a). E-commerce Business Models in the US Home Mortgage Industry, Paper presented at the Star 2003 Conference: Socio-economic Trends Assessment for the Digital Revolution (Milan, Italy, November 14, 2003a).

Markus, M.L., Steinfield, C. and Wigand, R. (2003b). The Evolution of Vertical IS Standards: Electronic interchange standards in the US home mortgage industry, Paper presented at the Proceedings of the Workshop on Standard Making: A Critical Research Frontier for Information Systems (Seattle, WA, December 12–14, 2003b).

Mortgage Technology (2005). MISMO: Study reveals MISMO ROI, *Mortgage Technology* January-February. [WWW document] http://www.mortgage-technology.com/plus/print_archive/?pub = MortgageTechnology&year = 2005&issue = T103&item = 7 (accessed 24 May 2005).

Mukhopadhyay, T., Kekre, S. and Kalathur, S. (1995). Business Value of Information Technology: A study of electronic data interchange, *MIS Quarterly* **19**(2): 137–156.

Olson, M. (1965). *The Logic of Collective Action; Public Goods and the Theory of Groups*, Boston, MA: Harvard University Press.

Peterson, P. (2004). 10th Anniversary of Automated Underwriting: A look back, a look ahead, Prepared Remarks for the Midwinter Executive Housing Conference. [WWW document] http://www.freddiemac.com/speeches/peterson/pp022704.html (accessed 24 May 2005).

Posner, K. and Courtian, M. (2000). *US Mortgage Finance – The Internet Mortgage Report II: Focus on Fulfillment*, New York: Morgan Stanley Dean Witter.

Punishill, J. (2001). *Resuscitating Mortgage Lending*, Cambridge, MA: Forester.

Sarkar, M.B., Butler, B. and Steinfield, C. (1995). Intermediaries and Cybermediaries: A continuing role for mediating players in the electronic marketplace, *Journal of Computer Mediated Communication* **1**(3), [WWW document] http://jcmc.indiana.edu/vol1/issue3/sarkar.html (accessed 1 September 2005).

Segars, A. and Grover, V. (1995). The Industry-level Impact of Information Technology: An empirical analysis of three industries, *Decision Sciences* **26**(3): 337–369.

Simons, K. (2001). Information Technology and the Dynamics of Firm and Industrial Structure: The British IT consulting industry as a contemporary specimen (No. 2001/83), Helsinki, Finland: United Nations University, World Institute for Development Economics Research.

Songini, M. (2001). Lack of Standards Blocks Supply-Chain Automation, *Computerworld* (April 5).

Steinfield, C., Kraut, R. and Plummer, A. (1995). The Effect of Networks on Buyer–Seller Relations, *Journal of Computer Mediated Communication* **1**(3), [WWW document] http://jcmc.indiana.edu/vol1/issue3/steinfld.html (accessed 1 September 2005).

Steinfield, C., Wigand, R. and Markus, M.L. (forthcoming). Promoting E-Business Through Vertical Information Systems Standards: Lessons from the US home mortgage industry, in S. Greenstein and V. Stango (eds.) *Standards and Public Policy*, Cambridge, England: Cambridge University Press.

Straka, J. (2000). A Shift in the Mortgage Landscape: The 1990s move to automated credit evaluations, *Journal of Housing Research* **11**(2): 207–232.

Tushman, M. and Anderson, P. (1986). Technological Discontinuities and Organizational Environments, *Administrative Science Quarterly* **31**(3): 439–465.

van Baalen, P., van Oosterhout, M., Tan, Y.-H. and van Heck, E. (2000). *Dynamics in Setting Up an EDI Community*, Delft, The Netherlands: Eburon Publishers.

Van Order, R. (2000). The US Mortgage Market: A model of dueling charters, *Journal of Housing Research* **11**(2): 233–255.

Wigand, R. and Benjamin, R. (1995). Electronic Commerce: Effects on electronic markets, *Journal of Computer Mediated Communication* **1**(3), [WWW document] http://jcmc.indiana.edu/vol1/issue3/wigand.html (accessed 1 September 2005).

Wigand, R., Steinfield, C. and Markus, M.L. (2005). IT Standards Choices and Industry Structure Outcomes: The case of the US home mortgage industry, *Journal of Management Information Systems* **22**(2), Fall, forthcoming.

Zuboff, S. (1988). *In the Age of the Smart Machine: The Future of Work and Power*, New York: Basic Books.

Author biographies

Charles Steinfield is a Professor of Telecommunication, Information Studies, and Media at Michigan State University, where he is the recipient of MSU's Teacher-Scholar and Distinguished Faculty awards. He conducts research on the applications of communication and information technologies for individuals, groups and organizations. He has received several National Science Foundation grants, worked in applied research at Bellcore, and was a senior Fulbright Scholar to France. He has been a visiting professor at several European institutes, including the Institut National des Télécommunications, France Telecom Research and Development, Delft University of Technology, the Telematica Instituut, Helsinki School of Economics and Business Administration, and Roskilde University. He has authored or edited five books, and his articles have appeared in such journals as *Communication Research*, *Information Systems Research*, and *Organization Science*. He holds a masters and Ph.D. from the Annenberg School for Communication at the University of Southern California.

M Lynne Markus is the John W Poduska, Sr. Chair in Information Management at the McCallum Graduate School of Business, Bentley College. Professor Markus conducts research on enterprise and interenterprise systems, knowledge management, and organization change. She is the author of three books and numerous articles in journals such as *MIS Quarterly*, *Information Systems Research*, *Journal of Management Information Systems*, *Organization Science*, and *Management Science*. She was named Fellow of the Association for Information Systems in 2004. She holds a B.S. in Industrial Engineering from the University of Pittsburgh and a Ph.D. in Organizational Behavior from Case Western Reserve University.

Dr Rolf T Wigand is the Maulden-Entergy Chair and Distinguished Professor of Information Science and Management at the University of Arkansas at Little Rock. He is the immediate past director of the Center for Digital Commerce and the Graduate Program in Information Management at Syracuse University. Wigand researches and consults in information management, electronic commerce and markets, IS standards and the strategic deployment of information and communication technology. His research interests lie at the intersection of information and communication business issues, the role of newer information technologies and their strategic alignment within business and industry. Wigand has taught

on the faculty of Syracuse University, Arizona State University, Michigan State University, Universidad Iberoamericana, Mexico City; and the University of Munich. His research has been supported by the National Science Foundation, the German National Science Foundation (DFG), the Volkswagen Foundation, the International Social Science Council, Rome Laboratory, and other funding agencies. He is an editorial board and review member of almost 30 academic and professional journals, book series and yearbooks. Wigand is the author of five books and over 110 articles, book chapters, and monographs.