Personal Statement

Chrysanthos Dellarocas

November 8, 2003

My research studies the effects of ubiquitous Internet connectivity on organizations and institutions. In particular, my current work focuses on understanding the impact of online word of mouth communities and reputation mechanisms on business and society. This is a long-term agenda that has already led to several publications, journal submissions, working papers, an NSF CAREER award, and an MIT/NSF co-funded symposium.

My publication record can be divided chronologically into early work and later work, reflecting my transition from a Computer Science Ph.D. to a Business School professor. My early work (before 2000) reflects my training and background in Computer Science and is published in Computer Science journals and conferences. My later work (from 2000 on) reflects my methodological transition into game theory and economics modeling and is aimed at more traditional information systems and management science journals.

The following sections provide a summary of my current and early work, my target audience, my teaching, and my plans for the future\textsuperscript{1}.

1 Current Work: Online Word-of-Mouth and Reputation Mechanisms

One of the most important new capabilities of the Internet relative to previous mass communication technologies is its bi-directionality. Through the Internet, not only can organizations reach audiences of unprecedented scale at a low cost, but also, for the first time in human history, individuals can make their personal thoughts, reactions, and opinions easily accessible to the global community of Internet users.

\textsuperscript{1}Throughout this document, numbered references of the form [number] refer to the corresponding publications listed in my Curriculum Vitae. References to the work of other authors are listed at the end of this document.
Word-of-mouth, one of the most ancient mechanisms in the history of human society, is being given new significance by this unique property of the Internet. Online feedback mechanisms, also known as reputation systems (Resnick et al., 2000), are using the Internet’s bi-directional communication capabilities in order to engineer large-scale word-of-mouth communities in which individuals share opinions and experiences on a wide range of topics, including companies, products, services, and even world events.

The proliferation of online word of mouth communities is already affecting organizations and institutions in important ways. For example, as early as 1994, the negative publicity generated through online feedback forums regarding an obscure and rather insignificant defect of the first generation of Pentium processors, led to hundreds of reports on the mass media, bad jokes on late-night television, and a $475 million fourth-quarter debit on Intel’s balance sheet (Coe et al., 1995). In December 2002, the vigorous denunciation of Senator Trent Lott’s controversial remarks in online “weblogs” forced the mainstream media (who, remarkably, had made a conscious or unconscious decision to not give publicity to the incident) to take notice and eventually led to Senator Lott’s resignation from his position as majority leader (Economist, 2002). In February 2003, Jeff Bezos, the CEO of Amazon.com decided to cancel all plans for any television or general-purpose print advertising because he believes that his company is better served through word-of-mouth generated through the Internet (Hansell, 2003).

There is growing evidence that consumers are influenced by online forums before making a variety of purchase decisions (Chevalier and Mayzlin, 2003). Howard Dean’s 2004 campaign shows that online forums can have an important impact in politics as well. It might well be that the ability to solicit, aggregate, and publish mass feedback will influence the organizational and social dynamics of the 21st century in a similarly powerful way in which the ability to mass broadcast affected business and society in the 20th century.

My work aims to better understand the implications of large-scale online feedback mechanisms for business and society, and well as to develop theory-backed guidelines for designing and operating such systems. My research style has been primarily theoretical, using game theory and computer science as the core reference disciplines. This is a long-term research program that is structured around two separate, but related, lines of investigation:

- “Big Picture” Questions: Understanding the implications of online word-of-mouth communities for business and society.
- Mechanism Design Questions: Understanding how efficient online feedback mechanisms should be designed and operated.

I am, of course, open to expanding my methodological toolkit to address the problems that interest me from many different angles. In fact, I am currently in the middle of my first two empirical studies (in collaboration with other colleagues).
In addition, I am actively involved in community-building around the topic of online reputation. I believe that closer interaction among researchers in this important interdisciplinary area will provide significant leverage in advancing this field of research and accelerate its practical application. In this spirit, I co-organized the highly successful First Interdisciplinary Symposium on Online Reputation Mechanisms (co-funded by MIT and NSF) that took place in Cambridge, MA on April 26-27, 2003. In addition, I have given numerous tutorials on this subject in conferences and workshops, have been interviewed at CNN Headline News, and have been quoted in, among other places, The New York Times and Esther Dyson’s Release 1.0 newsletter.

For a detailed account of my vision of this booming field, a survey of related work (including my own) and a viewpoint on the most important open research questions, the reader is encouraged to read my Management Science paper [1]. The following sections provide a summary of my recent and ongoing work in this field.

1.1 Research Objective 1: Understanding the Implications of Online Word-of-Mouth for Business and Society

Best known so far as a technology for building trust and fostering cooperation in online marketplaces (such as eBay), online feedback mechanisms are poised to have a much wider impact on organizations and society. Their growing popularity has potentially important implications for a wide range of economic and political activities, such as:

- **Brand building and customer acquisition.** Online feedback mechanisms can serve as a low-cost and, potentially, effective channel for acquiring and retaining customers. At the same time they quickly disseminate bad news that can potentially harm brand equity.

- **Product development and quality control.** Online feedback networks can assist an organization better understand consumer reactions to its current product line. At the same time, they reveal this information to competitors and they also accelerate the dissemination of information about product defects.

- **Supply chain quality assurance.** Industry-wide feedback mechanisms can assist organizations better assess prospective first-time suppliers; they can also act as a powerful disciplining mechanism that ensures fulfillment of contractual obligations and can potentially lower the legal costs of doing business.

- **Public opinion formation.** Online reputation mechanisms are emerging as an alternative channel for the formation and exchange of opinions on world events. Their interrelationship with traditional mass media is yet to be understood.
Part of my work aims to increase our conceptual understanding of how the existence of online word-of-mouth communities affects the established institutions in these and other areas of interest to organizations. The following paragraphs summarize my recent and ongoing work in this area.

Impact of online feedback on marketing. Empirical evidence suggests that consumers are increasingly influenced by online opinion forums (such as Epinions.com) before making a variety of purchase decisions. I am currently engaged in a detailed theoretical analysis of the impact of online forums on competition and marketing strategies. The project aims to address the following research questions:

- How should firms adapt their marketing strategies to react to the growing popularity of online opinion forums?
- How will the informativeness of online forums be affected by promotional chat and other intentional manipulation activities?
- In a competitive setting, who wins and who loses from the introduction of such systems?

My first working paper in this area [9] studies a duopoly setting where two firms simultaneously introduce imperfect substitute experience goods of different qualities. Firms attempt to influence consumer beliefs about their respective quality through dissipative advertising and online forum manipulation. My analysis concludes that:

- Although both firms will engage in forum manipulation, forums will retain their informativeness; at equilibrium, the relative amounts of manipulation will allow consumers to correctly infer the quality differential of the two firms.
- Forum manipulation initiatives will increase the marketing costs of both firms but will not substantially improve their sales revenues (because consumers cannot be fooled).
- Forum operators can help reduce such manipulation activity by installing technological solutions that increase the unit cost of forum manipulation and the amount of honest feedback contributed to such forums by consumers.
- The introduction of online forums will result in a reduction of traditional advertising expenditures and a shift of marketing resources into forum manipulation initiatives.

Online reputation mechanisms as a complement to tort litigation. Most commercial transactions rely on the legal system to assure performance of promises, which are written into explicit or implicit contracts. The legal system is expensive, however, in terms of the cost of the institutions necessary to adjudicate claims (lawyers, courts, etc.) and to enforce decisions (police, correctional facilities, etc.). As information technology dramatically reduces the cost of accumulating, processing and
disseminating consumer feedback, it is plausible to ask whether such mechanisms can provide an economically more efficient solution to a wide range of moral hazard settings where societies currently rely on the threat of litigation in order to induce cooperation. In [10, 13] we compare online reputation to legal enforcement as institutional mechanisms in terms of their ability to induce cooperative behavior and we explore the impact of information technology on their relative economic efficiency. We find that although both mechanisms result in losses relative to the maximum possible social surplus, under certain conditions online reputation outperforms litigation in terms of maximizing the total surplus, and thus the resulting social welfare.

I view the above papers as an initial step in exploring the impact of large-scale word-of-mouth networks on quality assurance market institutions. I do not foresee that such mechanisms will ever completely replace litigation, however, it is plausible that they might emerge as powerful complementary disciplining devices that result in a reduction of the legal costs of doing business. The role of such mechanisms is likely to be particularly important in markets for professional services, such as legal, medical, accounting, home improvement, etc. In these cases legal costs are likely to be high compared to the cost of high effort, it may be costly for a court to verify the quality of the service provided, and the outcome of the court’s evaluation may be noisy; all of these factors favor the relative attractiveness of reputation mechanisms for providing trust.

This line of work is particularly significant in view of the current turmoil surrounding medical litigation costs, as well as predictions that information technology will increase the role of markets for professional services. For instance, Malone and Laubacher (1998) have argued that we are moving towards an “e-Lance economy” with professional services auctioned off on an ad-hoc basis. Our analysis suggests that reputation mechanisms would play a central role in enabling this type of markets.

1.2 Research Objective 2: Incentive-based Online Feedback Mechanism Design

The use of word-of-mouth networks as a basis for social control is arguably as old as society itself. The advent of the Internet is adding some significant new dimensions to this age-old concept [1]. Most important among them is the ability to systematically design and control feedback networks through the use of properly architected information systems (feedback mediators). Feedback mediators specify who can participate in feedback communities, what type of information is solicited from participants, how it is aggregated, and what type of information is made available to them about other community members. They enable online community operators to exercise precise control over a number of parameters that are difficult or impossible to influence in brick-and-mortar settings. For example, feedback mediators can replace detailed feedback histories with a wide variety of summary statistics, apply filtering algorithms to eliminate outlier or suspect ratings, control the initial state of feedback profiles of new members, etc.
Through the use of information technology, what had traditionally fallen within the realm of the social sciences is, to a large extent, being transformed to an engineering design problem. The potential to engineer social outcomes through the introduction of carefully crafted information systems is opening a new chapter on the frontiers of information systems research. Further progress in this area requires a careful scoping of the design space of online feedback mediators, and theory-driven guidelines for selecting the most appropriate mechanism architecture for a given class of settings.

Part of my work is devoted into shedding light in the above research questions and therefore helping develop a systematic discipline of online feedback mechanism design. The following paragraphs summarize my recent and ongoing work in this area.

**Binary feedback mechanisms.** Binary feedback mechanisms represent perhaps the simplest family of feedback mechanisms. Such mechanisms solicit “binary” feedback (that is, they ask users to rate their experiences as either positive or negative) and publish aggregate statistics of the number of positive and negative ratings posted on a product, seller, etc. Apart from their simplicity and theoretical elegance, these mechanisms are practically important because they resemble the feedback mechanisms of electronic marketplaces, such as eBay and Yahoo Auctions. In [11] I offer a systematic exploration of online feedback mechanism design issues in trading environments with opportunistic sellers, imperfect monitoring of a seller’s effort level, and two possible transaction outcomes (corresponding to “high” and “low” quality respectively), one of which has no value to buyers. The objective of feedback mechanisms in such settings is to induce sellers to exert high effort and, therefore, to maximize the probability of high quality outcomes. The theoretical outcomes predicted by this paper are consistent with empirical observations and offer theory-backed explanations to hitherto poorly understood phenomena such as the remarkably low fraction of negative feedback on eBay\(^3\).

**Immunizing feedback mechanisms against untruthful ratings.** Feedback on online feedback mechanisms is usually subjective and difficult to verify. It is, therefore, to be expected that the various players interacting through feedback mechanisms will attempt to manipulate feedback mechanisms to their advantage, for example by praising their products or bad-mouthing those of their competitors. In [15, 16, 21] I analyze the potential impact of unfair feedback on online environments and I propose and evaluate a set of mechanisms, based on robust statistics, that significantly reduce the negative effects of such fraudulent behavior.

**Understanding the drivers of voluntary participation in online feedback communities.** The success of online reputation systems depends on the sustained (voluntary) contribution of feedback by community members. Noticeably missing from existing reputation systems research are analyses of the motivation for buyers to leave comments. Feedback submission is costly to the providers

\(^3\)Professor Drew Fudenberg has included this paper in the Spring 2003 syllabus of his doctoral course on Game Theory at Harvard University.
but benefits the whole trading community. Standard economic theory predicts that people are not inclined to contribute voluntarily to the provision of such public goods but, rather, they tend to free ride on the contributions of others. Nevertheless, empirical results from eBay show that buyers submit ratings to about 50% of transactions.

In [31] we offer an in-depth study of buyer participation in eBay’s reputation system. We find that buyer participation drops off as buyers gain experience, and that positive reciprocation keeps buyers participating at higher levels. Motivated by those findings, we propose and analyze a feedback mechanism extension that can help increase participation levels on eBay and similar communities.

**Inventing novel feedback mechanism architectures.** In [12] and [26] I am exploring how the indirect persuasive power of online feedback can be combined with the explicit power of a market mediator to levy listing fees or control communication between buyers and sellers in order to develop novel quality assurance mechanisms in online markets.

In [12] I propose a mechanism that combines the ability of electronic markets to solicit feedback from buyers with the more traditional ability to levy listing fees from sellers. Each period the mechanism charges a listing fee contingent on a seller’s announced expected quality. It subsequently pays the seller a reward contingent on both his announced quality and the rating posted for that seller by that period’s winning bidder. I show that, in the presence of a continuum of seller types with different cost functions, imperfect private monitoring of a seller’s effort level and a simple “binary” feedback mechanism that asks buyers to rate a transaction as “good” or “bad”, it is possible to derive a schedule of fees and rewards that induces all seller types to produce at their respective first-best quality levels and to truthfully announce their intended quality levels to buyers.

Most online feedback mechanisms publish unbiased statistics (usually averages) of past ratings. In [26] I show that such mechanisms fail in environments where the same seller sells products of many different qualities, such as marketplaces of used cars and collectibles. This paper presents a novel feedback management mechanism that succeeds in facilitating efficient transactions in such settings. One particularly interesting aspect of this mechanism is that it uses the threat of unfavorably biased future reporting of quality in order to induce sellers to truthfully declare the quality of their items.

2 Early Work

My work before 2000 reflects my background and training as a Computer Scientist. Highlights of my early work include Proteus (1991), one of the most widely used parallel architecture simulators during the 1990s, European and U.S. patents awarded for my work on the Process Handbook project (1998), a $1.6M funding award from DARPA (1998) to develop an exception handling infrastructure for software agent architectures, and one startup company (Phios Corporation) founded to commercialize the ideas that I helped develop.
Below I am briefly summarizing my early research projects in reverse chronological order.

### 2.1 Exception Handling in Multi-Agent Systems

Electronic marketplaces of software agents require the development of new architectures, capable of coping with unreliable computational and network infrastructures, limited trust among independently developed agents and the possibility of systemic failures. In analogy with human societies, I have taken the approach that agent marketplaces will benefit from the introduction of appropriate electronic exception handling services, whose role will be to help guarantee efficiency and fairness in the face of these challenges by detecting anomalous behavior and intervening to mitigate its undesirable effects.

My work in this area (with Dr. Mark Klein of the MIT Center for Coordination Science) has received a $1.6M four-year funding award by DARPA and has resulted in a prototype exception handling infrastructure for software agent environments. Our services work by listening to all messages exchanged by transacting agents. Based on a knowledge base of protocol patterns and associated common exceptions, our services are capable of detecting symptoms of anomalous behavior without needing to “understand” full details of the transaction domain. They then proactively engage in exception resolution procedures, which aim to bring the system back on track and minimize losses.

The basic principles of our approach are described in [20]. Our prototype environment has been successfully used to limit the delays associated with unanticipated agent death in decentralized supply chains. Our experiments with the system have been published in the top conferences [17, 18, 19, 32] and journals [2] of the software agents academic community and have been widely cited by other researchers in that field.

### 2.2 Exception Handling in Business Processes

The need to systematically manage exceptions in decentralized settings is becoming increasingly important not only in software agent environments, but also in every kind of process that spans organizational boundaries. In a spirit similar to that of my agents project, I have advocated the use of third party exception handling services, based on knowledge-driven automatic exception detection and resolution tools. I developed a prototype business process exception handling tool as an extension of the MIT Process Handbook. Papers [3, 4, 24, 28, 35] describe my work in this area.

My work in exception handling in business process has had tangible impact in business practice. The ideas and architecture described in the above cited papers are now being put into practice by a number of startup companies producing operational risk management tools. One such startup, Premonition Technologies, has actively sought our advice and has retained my associate Dr. Mark
Klein as an advisor (I was offered that opportunity first but declined in order to focus on my research).

2.3 MIT Process Handbook

From 1992 to 1995 I pursued my doctoral thesis as a member of the Process Handbook group at the Center for Coordination Science at MIT. I developed the first prototype version of the Process Handbook software and, to this date, remain closely involved in the specification of successive prototype versions of the tool. In addition to helping develop the software, I have played a significant role in the evolution of the concepts of the project. My contributions are described in [5, 7, 42]. As a result of this work, I was awarded US Patent No. 5,819,270 and European Patent No. 0692113.

2.4 Component-based Software Engineering

My doctoral thesis [49] investigated the application of the principles of coordination theory in facilitating the development of new applications from software components. More specifically, the thesis demonstrated that the interconnection and coordination aspects of a software system could be usefully separated from the description of core functionality of software components. In this way the assumptions components make about the rest of the system are minimized and their ease of reusability is maximized. My doctoral work resulted in the development of Synthesis, a prototype component-based software development toolset embodying the above principles. Synthesis uses a separate notation for expressing the interconnection aspects of software systems. It relies on a knowledge base of software interconnection expertise for automatically translating such descriptions into “glue code” that is integrated together with core components to form executable systems. Synthesis has been successfully used in order to integrate a number of independently developed components into new applications with minimal need for additional, manually written, “glue code”. The results of the project have been published in [38, 39, 40] and reprinted in a recent MIT Press book [22, 23, 25].

2.5 Proteus: A Parallel Architecture Simulator

My master’s thesis at the MIT Laboratory for Computer Science [44, 52, 53] involved designing and developing Proteus, a parallel computer architecture simulator. Proteus was built to assist researchers who are developing parallel algorithms, but do not have access to expensive parallel computers in order to test them. The system stood out by being able to reconfigure itself, in order to simulate many different classes of MIMD (multiple instruction, multiple data) architectures. It also was about two orders of magnitude faster than other comparable tools available to the research
community at that time. Proteus has been extensively used by university researchers worldwide in the 1990s. One of our experiments for assessing the usefulness of Proteus resulted in the invention of a novel parallel search algorithm, which was published in a top IEEE journal [6].

3 Target Audience

My target audience includes the IS community, the E-Commerce/Algorithmic Game Theory community within Computer Science, and the Economics of the Internet community.

*IS community.* I maintain close ties with the IS community by presenting my work at ICIS, WISE (and previously WITS), by refereeing papers for top journals of that community (Management Science, Information Systems Research), and by being closely involved in the organization of WISE and ICIS. I served as an Associate Editor of ICIS in 2002 and have been elected to be a co-chair of WISE 2004 (with Eric Clemons and Lorin Hitt). My recent publications are primarily aimed at the top journals of the IS community. Two papers of mine have been accepted at *Management Science* and two more papers are currently under review at *Management Science* and *Information Systems Research* respectively.

*E-Commerce/Algorithmic Game Theory.* One of the most remarkable new paradigms, influencing research in computer science recently, is a new body of algorithmic and computational methods for solving and arguing about problems related to Game Theory which are motivated by the Internet. Algorithmic Game Theory is a novel area of research that combines algorithmic thinking with concepts from the Game Theory, as well as the realities of the Internet, in order to better understand it. As is common in Computer Science, most of the action in this community takes place around conferences and seminars. Since 2000 I have had a constant presence at the *ACM Conference on Electronic Commerce*, the most prestigious venue of that community (paper acceptance ratios typically below 20%), with 1-2 accepted papers per year. In 2001 I served as its tutorials chair and in 2004 I am a member of the program committee. This year I have been invited to the exclusive by-invitation-only Schloss Dagstuhl seminar on Algorithmic Game Theory and the Internet.

*Economics of the Internet.* I am actively building ties with economists who are interested in the economics of the Internet. I have been invited to the SITE (Stanford Institute for Theoretical Economics) conference on the Economics of the Internet in June 2002. I have also been invited to give seminars at IDEI (Institut d’Economie Industrielle) in Toulouse, France and Univestitat Pompeu Fabra in Barcelona, two of the top centers of excellence in economics in Europe.
4 Teaching

The combination of my Computer Science background and my work experience as a management consultant at Andersen Consulting (now Accenture) and McKinsey makes me a versatile business school teacher who is equally comfortable teaching technology or management cases. I take teaching seriously and I derive immense satisfaction from it.

My courses at MIT Sloan are consistently receiving excellent student evaluations (averaging 4.5/5.0 and above) and have served as the model for similar courses in several other U.S. and international business schools.

From 1996-1999 I taught the "technology" course of the Information Technology track (15.564 Information Technology I). This course provides an introduction to the technical aspects of computer, database and network technologies for business school students. The course is unique in that it attempts to cover a very broad range of topics and also provide some depth in each of them. It aims for a balance between theory and hands-on experience with key applications, such as Microsoft Access.

The intended audience includes Sloan MBA students, Sloan undergraduates majoring in information technology and out-of-course students. The wide diversity of student backgrounds in IT makes developing and teaching this course especially challenging. Nevertheless, the course was oversubscribed in all terms that it was offered. Students rated the course highly; the average rating from student evaluation forms was over 4.5 out of 5, making it one of the highest rated courses offered by the Sloan IT group in recent years (see Appendix).

In the Spring 2000, I developed a new course for the Sloan School’s eBusiness track. The title of the course is “eBusiness Technologies”. The purpose of this course is to provide future managers with a broad introduction to the technologies that are enabling the eBusiness revolution. Using a combination of lectures, hands-on assignments and case studies, the course covers both the fundamental building blocks of today’s Web-based systems (databases, networks, clients and servers) as well as the most important classes of applications that enable today and tomorrow’s electronic businesses. The new course has been phenomenally popular, with a waiting list, which exceeded the class list. It has also received excellent student evaluations on both years when it was taught (Spring 2001 evaluations: Recommend subject: 4.55, Recommend professor: 4.79.)

I spent last year on sabbatical at NYU’s Stern School of Business, where I taught an elective course on Advanced Technologies for Business Applications. The course received excellent teaching ratings and student comments. One student commented that that course was “an amazing learning experience. The best course I have taken at Stern.”
Last, but not least, I have contributed sessions to a number of executive education seminars organized by the Sloan School, including the highly successful 1999 and 2000 YPO (Young Presidents Organization) seminars, in which all the participants were young CEOs.

5 The Future

I have every reason to believe that the coming years will be an extremely productive period for me. I have a concrete research agenda on a topic that is widely considered to be of high importance. My recent working papers have been well received by a number of audiences spanning IS researchers, economists, and computer scientists with interest on algorithmic game theory. The NSF/MIT-funded symposium on reputation mechanisms I co-organized this year has generated high interest from a number of prominent figures in these fields as well as from industry.

Right now I have two journal papers under review at top journals. I am optimistic that by the end of the academic year I will have three more journal submissions: a journal version of [12], a study on the motivations for voluntary online feedback submission on eBay [31], and a study on the impact of online feedback mechanisms in marketing and advertising [9].

My short-term goals include having at least one of my papers accepted at a top economics journal within the next 24 months. In the medium-term, I intend to strengthen my collaboration with researchers from other disciplines, such as empirical and experimental economists, in order to perform theory-driven field studies and experiments on how humans react to different types of feedback mechanisms. I also have a strong interest in helping found an interdisciplinary research center focused on the study of these mechanisms and their impact on organizations and society from a variety of complementary angles.

References


