Reputation Systems:

Facilitating Trust in Internet Interactions

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The Internet has created vast new opportunities to interact with strangers. The interactions can be fun, informative, even profitable. But they also involve risks. Is the advice from a self-proclaimed expert at expertcentral.com reliable? Will an unknown dot-com site or eBay seller ship with appropriate packaging, and will the product be as described?

Before the Internet, such questions were answered, in part, through reputations. Vendors provided references, Better Business Bureaus tallied complaints, and past personal experience and person-to-person gossip told you whom you could rely upon and whom you could not. And a businessman's standing in the community, e.g., his role at church, served as a valuable hostage.

Internet services operate on a vastly larger scale than Main Street and permit virtually anonymous interactions. Nevertheless, reputation systems are playing a major role. Systems are emerging that respect anonymity and operate on the Internet's scale. A reputation system collects, distributes, and aggregates feedback about participants' past behavior. Though few of the producers or consumers of the ratings know each other, these systems help people decide whom to trust, encourage trustworthy behavior, and deter participation by those who are unskilled or dishonest.

For example, consider eBay, the largest person-to-person online auction site, with more than 4 million auctions open at a time. eBay offers no warranty for its auctions; it only serves as a listing service while the buyers and the sellers assume all the risks associated with transactions. There are fraudulent transactions to be sure. Nonetheless, the overall rate of successful transactions remains astonishingly high for a market as "ripe with the possibility of large-scale fraud and deceit" as is eBay [ref. Kollock].

eBay attributes its high rate of successful transactions to its reputation system, the Feedback Forum. After a transaction is completed, the buyer and seller have the opportunity to rate each other (1, 0, or -1) and leave comments ("*Good transaction. Nice person to do business with! Would highly recommend*."). Each participant has his running total of feedback points attached visibly to

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his screen name, possibly a pseudonym. Yahoo! Auction, Amazon and other auction sites feature reputation systems like eBay's, with variations such as a rating scale from 1-5, or using several measures (friendliness, prompt response, quality product, etc), or averaging rather than totaling feedback scores.

Reputation systems have spread far beyond auction sites. Bizrate.com rates registered retailers by asking consumers to complete a survey after each purchase. So-called "expert sites" (www.expertcentral.com, www.askme.com) provide Q&A forums in which experts provide answers for questions posted by clients in exchange for reputation points and comments. Product review sites (www.epinions.com) offer rating services for product reviewers—the better the review, the more points the reviewer receives. iExchange.com tallies and displays reputations for stock market analysts based on the performance of their picks.

Why are these explicit reputation systems so important for fostering trust among strangers? To address this question, it helps to examine how trust builds naturally in long-term relationships. First, when you interact with someone over time, the history of past interactions informs you about the other party's abilities and disposition. You learn when you can count on that party. Second, the expectation of reciprocity or retaliation in future interactions creates an incentive for good behavior. Robert Axelrod refers to this as the "shadow of the future" [ref. Axelrod], an expectation that people will consider each other's past in future interactions. That shadow constrains behavior in the present.

Between strangers, on the other hand, trust is much harder to build, and understandably so. Strangers do not have known past histories or the prospect of future interactions, and they are not subject to a network of informed individuals who will punish bad and reward good behavior toward any of them. In some sense, a stranger's good name is not at stake. Given these factors, the temptation to "hit and run" outweighs the incentive to cooperate, since the future casts no shadow.

Reputation systems seek to restore the shadow of the future to each transaction by creating an expectation that other people will look back upon it. The connections of such people to each other may be significantly less than is the case with transactions on a town's Main Street, but their numbers are vast in comparison. At eBay, for example, a stream of buyers interacts with the same seller. They may never buy an item from the seller again, but if they share their opinions about this seller on the Feedback Forum, a meaningful history of the seller will be constructed. Future buyers, having no personal history, may still base their buying decisions on a sufficiently extensive public history. If buyers do behave this way, the seller's reputation will affect her future sales. Hence, she will seek to accumulate as many positive points and comments as possible, and avoid negative feedback. Through the mediation of a reputation system, assuming buyers provide and rely upon feedback, isolated

interactions take on attributes of a long-term relationship. In terms of building trust, a vast boost in the quantity of information compensates for a significant reduction in its quality.

For anyone simply trying to sell off, say, their old LP collection, reputation systems might seem like a nuisance. But consider such an effort in a market with no reputation system, and hence no obvious distinction between different quality sellers (i.e., quality of goods, shipping, etc.). Buyers would be reluctant to pay full prices given the uncertainty about the seller's quality (e.g., whether the seller reveals scratches in the records at the time of sale), hence would scale back their offers. High-quality sellers, however, would be reluctant to accept discounted prices. Over time, high quality sellers would desert out of the market. Eventually, only the lowest quality sellers would remain, in a dynamic that economist George Akerlof memorialized as the "Market for Lemons" [ref. Akerlof]

Reputation systems can reverse this flow, and "unsqueeze" the bitter lemon. With clear reputation markers, low quality sellers receive lower prices, leaving a healthier market with a variety of prices and service qualities. For example, sellers with stellar reputations may enjoy an extra premium on their services—a premium that users may be willing to pay for the security and the comfort of high quality services. Such premiums are observed in auctions in two coin categories on eBay [ref. Lucking-Reiley; Bajari]. Benefits of informative reputation systems return to both buyers and sellers. A reputation system may make it possible to have those old LPs spin out the door.

The ratings themselves are not the only way to convey reputations. When agreeing to be rated is optional (e.g., registering as a retailer at bizrate.com), doing so is a first indication of higher quality services, even before any ratings are available. Using one's real name, rather than a pseudonym, and offering a website that makes it clear that one has a physical store and overhead costs, are also ways to indicate quality.

To operate at all, reputation systems require three properties at a minimum:

Entities are long-lived, so that there is an expectation of future interaction.

Feedback about current interactions is captured and distributed. Such information must be visible in the future.

Past feedback guides buyer decisions. People must pay attention to reputations.

In the offline world, capturing and distributing feedback is costly. Businesses often collect feedback from consumers, but they tend not to publicize the complaints. A few independent services, such as Zagat's for restaurants and Consumer Reports for appliance repair histories, systematically capture and disseminate feedback. For the most part, however, reputations travel haphazardly by word of mouth, through rumors, or through the mass media.

The Internet can vastly accelerate and add structure to the process of

capturing and distributing information. To post feedback, a user need only fill out an online form; often a mere mouse click will do. In cases where interactions are electronically mediated, objective information about performance may be captured automatically (e.g., delay from question to response at an expertise site). Thus, the same technology that facilitates market-style interactions among strangers also facilitates the sharing of reputations that maintain trust.

Despite the promise of reputation systems, there remain significant challenges requiring further research and commercial development. Consider each of the phases of operation for such systems: eliciting, distributing, and aggregating feedback.

Eliciting feedback encounters three related problems. The first is that people may not bother to provide feedback at all. For example, when a trade is completed successfully at eBay, there is little incentive to spend another few minutes filling out a form. That many people do so is a testament to their community-mindedness, or perhaps their gratitude or desire to exact revenge. People could be paid for providing feedback, but more refined schemes, e.g., paying on the basis of concurrence with future evaluations by others, would be required to assure that their evaluations were careful.

Second, it is especially difficult to elicit negative feedback. For example, at eBay it is common practice to negotiate first before resorting to negative feedback. Therefore, only really bad performances are reported. Even then, fear of retaliatory negative feedback or simply a desire to avoid further unpleasant interactions may keep people quiet. In the end, information about patterns of moderate discontent may remain invisible, and hence buyers can not shun sellers who foster such discontent.

The third difficulty is assuring honest reports. One party could blackmail another—that is, threaten to post negative feedback unrelated to actual performance. At the other extreme, in order to accumulate positive feedback a group of people might collaborate and rate each other positively, artificially inflating their reputations.

Distributing feedback, the third phase, also poses challenges. The first is name changes. At many sites, people choose a pseudonym when they register. If they register again, they can choose another pseudonym, effectively erasing prior feedback. Reputations can still have an impact, since newcomers will want to accrue positive feedback and those with established reputations will want to avoid negative feedback. Game theoretic analysis, however, demonstrates that there are inherent limitations to the effectiveness of reputation systems when people can start over with a new name [ref. Friedman and Resnick]. In particular, newcomers (those with no feedback) will always be distrusted until they have somehow paid their dues, either through an entry fee or by accepting more risks or worse prices while building up a reputation. Another alternative is to prevent name changes, either by using real names, or

by preventing people from acquiring multiple pseudonyms, a technique called once-in-a-lifetime pseudonyms [ref. Friedman and Resnick].

A second difficulty in distributing feedback stems from lack of portability between systems. Amazon.com initially allowed users to import their ratings from eBay. eBay protested vigorously, claiming that their user ratings were proprietary. Ultimately Amazon discontinued its rating-import service. Limited distribution of feedback limits its effectiveness: the future casts a shadow on only one on-line arena rather than many. Efforts are underway to construct a more universal framework. For example, virtualfeedback.com provides a rating service for users across different systems, but it has yet to gain wide public acceptance.

Finally, there is also a potential difficulty in aggregating and displaying feedback so that it is truly useful in influencing future decisions about who to trust. eBay displays the net feedback (positives minus negatives). Other sites such as Amazon display an average. We believe that these simple numerical ratings fail to convey important subtleties of online interactions.. For example, did the feedback all come from low-value transactions? What were the reputations of the people providing the feedback?

As a solution to the ubiquitous problem of trust in new short-term relationships on the Internet, reputation systems have an immediate appeal—the participants themselves create a safe community. Unfortunately, reputation systems confront many complex challenges, many of which yield no easy solutions. Efforts are underway to address these problems from a variety of angles. Our Reputation Research Network (see Sidebar) represents a first step at recognizing reputation systems as both a subject of study and a vital asset for the safety of online interaction environments.

Internet-based reputation systems, like traditional markets, aggregate vast amounts of information, which then significantly influences choices made by individuals and firms. But the parallel may end there. The theoretical underpinnings of the effective operation of markets are well understood, and the aggregation to a brief set of sufficient statistics -- namely a single price for each item -- proceeds automatically.

Reputation systems, by contrast, shouldn't work in theory. Individuals should not make the effort to provide evaluations; negative evaluations should be avoided completely; and vendors should develop sophisticated ways to manipulate and trick the system. Even if all reporting were complete and honest, users would find it virtually impossible to utilize the torrents of information they receive on other participants, given that no satisfactory summary statistics exist.

Despite their theoretical and practical difficulties, it is reassuring that reputation systems appear to perform reasonably well. Systems that rely on the participation of large numbers of individuals accumulate trust simply by operating effectively over time. Already, Internet-based reputation systems perform commercial alchemy. On auction sites, for example, they enable trash

to be shuttled across the country and in the process be transmuted into treasures.

It is fitting that we conclude with an allusion to democracy, another theoretically flawed and practically challenged system that nonetheless appears to perform miracles. Were Churchill to comment on reputation systems and building trust as he did on democracy and government, he might say:

> "Reputation systems are the worst way of building trust, except for all those other ways that have been tried from time to time."

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SIDEBAR

Are you interested in following the latest developments in reputation systems? Have you noticed a new system that you think researchers should be paying attention to? Then visit (and join) the Reputations Research Network (http://databases.si.umich.edu/reputations).

The network includes researchers from computer science, economics, sociology, and management. On the site, there are links to academic papers, to working systems, and to news articles. You can suggest additional links to add

to these collections, and you can add comments about any of them. New members are welcome.