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ABSTRACT

Web 2.0 has transformed how reputation systems are designed and used by the Web. Based on a thorough review of the existing online reputation systems and their challenges in use, this paper studied a case of Amazon's reputation system for the impacts of Web 2.0. Through our case study, several distinguished features of new generation reputation systems are noted including multimedia feedbacks, reviewer centered, folksonomy (use of tag), community contribution, comprehensive reputation, dynamic and interactive system etc.. These new developments promise a path that move towards a trustworthy and reliable online reputation system in the Web 2.0 era.

Keywords (Required)

Online reputation system, Web 2.0

INTRODUCTION

As the Web becomes increasingly distributed with content being created on the edge, and large numbers of individuals and organizations use Internet media to research/exchange information, and to conduct business transactions, the need for establishing trust mechanisms within online communities in order to facilitate these activities becomes apparent.

An online reputation system is the primary mechanism used by online markets to collect, distribute, and aggregate feedback about participants' past behavior and help people to decide whom to trust, and to encourage trustworthy behavior. It is argued that in order to effectively foster trust among strangers, it is important to track historic data, and establish the "shadow of the future" in an online environment (Resnick, Zeckhauser, Friednam, and Kuwabara, 2000). Among the existing reputation systems, ebay's feedback forum is one of the most studied. ebay's system allows buyer and seller to rate each other and leave comments after each transaction, the cumulative feedback score is then visibly displayed along each user's screen name. Empirical evidence indicates that sellers with better reputations are more likely to sell their items on ebay (Resnick, and Zeckhauser, 2002). In fact, the overall commercial success of eBay is largely attributed to the design of its reputation system (Resnick et al 2000, Dellarocas, 2003a, 2003b, Jøsang, Ismail, and Boyd, 2007).

While the importance of online reputation system is certainly evidenced by its adoption in electronic markets, the various designs of existing online reputation systems are far from ideal. In fact, they have encountered various issues that potentially affect their usability and effectiveness (Malaga 2003). Some commonly identified problems associated with online reputation systems include: (1) Low incentive for providing rating; (2) Bias toward positive rating; (3) Lack of effective mechanisms against unfair ratings; (4) change of identities after reputation loss; (5) Quality variations over time; etc. (Josang et al 2007). Those problems have become the bottleneck for the development of online reputation systems and severely diminished the value of those older systems in enhancing web trust.

Among all the efforts to remedy the drawbacks of online older reputation systems, Web 2.0 movement emerged from recent evolution of web technology have set promising prospects for next generation of online reputation systems. Initially a term coined by Tim O'Reilly(2007), Web 2.0 distinguishes itself from Web 1.0 through its empowerment of ordinary users to create, control, and share web contents, which contribute to collective intelligence (O'Reilly, 2007). From Google AdSense, Flickr, to Wikipedia, blogging, and tagging (folksonomy), applications of Web 2.0 emphasizes openness, community and interaction (Millard and Ross, 2006). The set of Web 2.0 principles has redefined how individuals and businesses should communicate, interact, and transact through the web, and hence revolve the design principle and future path for online reputation systems in particular.

This paper reviews the status quo of existing reputation systems and describes potential directions for future work in Web 2.0 era. First, reputation systems are defined and categorized according to their input, processing, and output. Weakness of reputation systems in pre-Web 2.0 era will then be described. Afterwards, the paper presents Web 2.0 and its impacts on the design of online reputation systems by a case study of the reputation system at Amazon.com. The paper concludes with a summary.

REPUTATION AND REPUTATION SYSTEMS

Reputation represents "the beliefs or opinions that are generally held about someone or something." (Oxford English Dictionary). What is interesting about reputation is that it is often characterized as context-specific, multifaceted, and dynamic (Windley, Tew, and Daley, 2007). That is to say, the same products, people or organizations could be viewed completely according to the situation they get involved, the criteria or aspect they are judged by, and the time when they are judged. For instance, the same publisher's reputation can be evaluated differently according to buyers' group, from several aspects including the quality of publications, the price, and the services etc, and will increase or decrease with users' further experiences.

In a web environment, online reputation systems are important mechanisms for identifying the credits of products, individuals, and organizations. These systems form "large-scale online word-of-mouth communities in which individuals share opinions on a wide range of topics, including companies, products, services, and even world events" (Dellarocas, 2000, 2003b). Typically, there are three major properties necessary for a reputation system to function: (i). authenticating the subject is who they claim to be, (ii). determining the subject is capable of performing some specific service, and (iii). determining if the subject can consistently deliver the desired result (Lin et al. 2006). Those properties can be partially derived from online communities' metadata about users, artifacts, and evaluations. Metadata of an online community also captures links between types of metadata. For instance, authors and creators can be linked to objects. Additionally, reviews and evaluations can also be linked to objects, as well as objects being linked to evaluations. The linking of data in this way can be useful to reveal patterns of behavior in online discussion groups as well as provide demographic information about participants and their product evaluations (Gleave and Smith, 2007).

ONLINE REPUTATION SYSTEMS OVERVIEW

System Input

Online reputation system captures individual or organization's reputation through either explicit or implicit information. Explicit information is information that is entered in an online system by a user, e.g. rating score or vote. The explicit information, once entered, can be summarized, and used to generate reputation scores that reflect the past behavior of a participant based on certain modeling equations. Among reputation system using explicit information, ebay is one of the most successful and famous. Implicit information, however, is derived without the user's knowledge. Implicit reputation is related to network behavioral data, for example, how a user travels through a series of web pages, how much time a user spends in an online store, on shopping history, or using transaction history (Jensen et al., 2003). A number of social communities such as Facebook, MySpace, Friendster, and LinkedIn have used implicit social network data to build community member's reputation.

System Processing

Reputation information can be processed on either centralized servers or distributed network.

Centralized reputation system requires reputation metadata under control of a central authority for the system. In these systems, information about the performance of a given product/service/participant is collected from other members in the same community who have had direct experience with that product/service/participant and is maintained on a central server. The central authority collects all the reputation measures and derives a reputation score for every product/service/participant, and makes all reputation scores publically available (Josang et al 2007). The primary mechanisms for the centralized reputation systems to generate reputation scores are e-rating and e-voting, both of which capture explicit information, and access statistics that captures implicit information of users.

E-rating is a mechanism to have users input their evaluation for quality of transactions for sellers and buyers in commerce exchanges or quality of content in knowledge exchanges. For commerce exchange, e-ratings show the history of the buyer and seller and the evaluation of their transaction experiences on a given scale basis. For knowledge exchange, e-ratings let anyone with access to post messages can leave feedback. Both eBay and Amazon used e-rating to provide a public view of participants past behavior, in which a central trusted server gathers transaction information, and calculates participant reputation scores. In ebay case, they use +1 for a positive feedback, -1 for a negative feedback, and 0 for neutral. The equation for them to compute reputation scores is simply a sum of all reputation rating input from past transaction. These e-

rating systems have made it possible for complete strangers in different geographical areas to determine whom they would choose to do business with on the Web.

E-voting also called ballot box communication (BBC) is an enumeration mechanism that aggregates individual votes and offers limited choices of communication to all participating users. The goal of e-voting is to reveal the interests of the mass population and reflect a many-to-one voice (Xia, Huang, Duan, and Whinston, 2007). With simplified options like Yes/No and Good/Poor, E-voting lowers the cost of participation and reduce the time users need to spend on leaving input. This encourages more people to participate. Sites using e-voting include Flickr.com, YouTube.com, Digg.com, and del.icio.us. However, because e-voting systems rarely provide audit information about users and patterns of participation within a community, their results could be manipulated. Since little knowledge is captured about individual actions and backgrounds during the voting process, e-voting does not enhance the depth of participation too.

Access statistics can be gathered based on popularity by evaluating view rankings, number of visitors, and number of comments. Access statistics are often released in conjunction with e-rating and e-voting scores. While access statistics do not indicate the opinions of visitors on the quality of transactions in commerce change and that of content in knowledge exchange, they imply the popularity of the product or content. This popularity often reflects one important aspect of reputation, especially for digital products like music, movies, and information posts.

Decentralized reputation systems are lack of central authority for reputation metadata control and computation. Since reputation information is distributed through the network and hosted on many different nodes, reputation systems in decentralized P2P networks need to take locally generated reputation information and spread it throughout the network to produce a global reputation rating for the nodes.

The mechanisms for a decentralized reputation system to generate reputation scores depends on whether reputation is measured by peers' objective activities, or subjective ratings from the other peers who have interaction with the target peers. Using peers' objective activities for reputation statistics is similar to access statistics reviewed in centralized reputation system, which is relatively easier to summarized and collected(Gupta, Judge, and Ammar, 2003). Using peer subjective ratings to generate reputation scores in a P2P network, however, is more complicated and requires considerable academic work in developing algorithms than e-rating and e-voting in centralized reputation system. Currently, those works have followed two directions: probabilistic estimation and social network (Despotovic and Aberer, 2005). The probabilistic estimation methods use well known estimation techniques, e.g. maximum likelihood estimation and Bayesian estimation, and a small portion of the globally available feedback to assess the reputation of individual peer. In contrast, the social network approach aggregates the globally available feedback in the network in order to assess the reputation of a single node. Some P2P network like Kazza used a hybrid mechanism combining both objective peers' activities and subjective ratings to generate reputation scores. Kazza define peers' reputation according to their participation level and their rating of file integrity. For Kazza, participant level is the ratio of Mbytes uploaded and downloaded that varies between 0 and 1000 with new user starting at a medium participation level of 100. The integrity of files is rated by each user as excellent, average, poor, or delete file.

System Output

Most of the existing reputation systems release reputation information by simply displaying a score, a scale, and/or comments along with the objects. While accompanying objects with their reputation scores provide straight shot on the historic quality of the transactions or contents and individual's past behaviors, there are several apparent limitations. First, reputation information is scattered across the website and difficult to aggregate, categorize, and compare with each other. Second, while reputation information could be analyzed and used internally, more often they are output automatically onto the website. Use of reputation information by those sites appear to be reactive not proactive so far. There are few reports on the practices of using reputation information for developing strategies and policies, or reaching customers for ecommerce sites or online communities. Finally, other than numeric scores or scales, there are less multimedia data used for reputation releases.

PROBLEMS WITH PRE-WEB2.0 ONLINE REPUTATION SYSTEMS

Although existing online reputations systems can induce beneficial outcomes to ecommerce system and online communities, they often fail because of inherent weaknesses that have not been well solved (Resnick et al. 2000, Malaga, 2004).

First, online reputation often misrepresents the performances of community participants and could be artificially inflated or deflated by the malicious actions of participants. Creating incentives for participants to leave feedback is a big challenge to online communities. Many community participants fail to leave feedback. Of the ones who do leave feedback,

it is difficult to ensure that the participants' reports are honest. One participant could blackmail another and threaten to post negative feedback that is unrelated to actual performance. Participants could also collaborate and rate one another positively, and collude against a competitor by providing negative ratings (Resnick 2000).

Second, the anonymity characteristic of many online communities makes it very difficult for reputation systems to identify participants and trace their prior histories. It is very easy to create a web identity, or multiple web identities in online communities. People choose pseudonyms at will and can change their identities and erase prior history. Lacking a history make the trust rating impossible because there is nothing to base a prediction of future behavior. Participants that have established a reputation are concerned about their ratings because of the time it takes to build their history.

Third, reputation accumulated in one community cannot be shared on another site, causing portability problems. Participants' reputation could be considered proprietary and prohibited from sharing out of the community that generates those reputations. Many participants themselves also have concerns about privacy and reluctant to carry over their reputation scores. In addition, the methods and time-periods used by different communities are not consistent and often difficult to be converted from one to the other. Lack of portability make users have to manually compare the reputation of the same item while traveling to different communities.

The fourth problem is miscalculation of reputations (Malaga, 2004). Many reputation systems used an overall reputation score that is a simple sum of each individual reputation rating. However, such calculations are unable to compare participants who have pure positive ratings and those who have the same overall scores but the scores are from a sum of both positive and negative rating. A general reputation score also doesn't reflect the multifaceted nature of the reputation of a participant. One participant can be very helpful and honest on one subject but not the others. Besides, the method does not count the time and context of a reputation score.

Finally, most of reputation systems today only exploit explicit information like online feedback for reputation calculation. Some of the problems above like misrepresented feedback, pseudonyms, and inaccurate reputation calculation etc to some extent are the results of the use of explicit information. Recently, social network analysis is emerging as a path to the right direction to use implicit information for reputation system. However, there are many problems remain to be solved. For example, the visibility and use of social network data in online communities may affect user confidence in reputation systems because participants of online communities have high privacy expectations.

ONLINE REPUTATION SYSTEMS IN WEB 2.0 ERA

While some of Web 2.0's enabling technology components have existed since the early days of the Web, the so called Web 2.0 is more about a set of principles that redefines how individuals and businesses should communicate, interact, and transact through the web (Lessig, 2006). Anderson (2007) highlighted six key principles of Web 2.0:

- Individual production and user generated content
- Harness the power of the crowd
- Data on an epic scale
- Architecture of participation
- Network effects
- Openness

Those principles together encourage users' participation and creativities, capture individual actions to produce collective results, use mass data volume matters and facilitate community and network building among users, and support open data exchange with open standards. The Web 2.0 movement have since influenced many facets of Internet culture and inspired innovative companies to create newer reputation systems to better service customers in the global economy.

In order to illustrate the deep impacts of Web 2.0 on the online reputation systems, we conduct a case study on the reputation systems of Amazon.com. This site is selected because: First, Amazon is a very successful eCommerce company. In 2008, when the entire retailer sector suffered seriously from decreased consumer spending in the economy recession, Amazon still reported "the best Christmas season ever"—a full year profit $645m for 2008, or a 36% increase from 2007's profit (Amazon Press Release, 2009 Feb). Second, Amazon is a well established Web 2.0 company. In fact, the notion of "long tail" (Anderson 2006) – a key justification of Web 2.0 economic model -was inspired by the analysis of the sales trends at Amazon. Third, both authors have been long term customers and contributors of Amazon's online reputation systems. The authors have witnessed the migration of Amazon's online reputation system into a Web 2.0 version. Our interests here are to

understand whether Amazon's Web 2.0 online reputation system is able to address the weaknesses of pre-Web 2.0 reputation systems. Our case findings are first presented in table below and then described:

Table 1 A Comparison of Amazon Pre Web 2.0 Reputation Systems and Web 2.0 Reputation Systems

Pre Web 2.0 Reputation System	Web 2.0 Reputation System
Score/scale/text	Multimedia input
Explicit action required	Implicit reputation derived
Product centered reputation	Reviewer centered reputation
Individual contribution	Community contribution
Single dimension	Comprehensive
Static	Dynamic
Reactive	Interactive

Multimedia feedbacks: Amazon.com encourages users to create and share reviews in the multiple formats including texts, images and videos. The earlier online reputation systems at Amazon tend to use scores/ratings to aggregate reputation information only. Now, Amazon accepts multimedia feedbacks including text reviews, customer images and videos, which complement the average score rating with richer information and help to reduce the misinterpretation of reputation scores. Often, a picture is worth a thousand words, and a single still image may confer very complex ideas. For example, one product's images can really provide a good sense of product dimension by comparing it with other familiar objects. These types of review are very useful especially when potential customers cannot see, feel, and touch the physical product in the online context. Sometimes, the customer images may even serve as the evidence of product uses, for example, images taken using the digital camera under review, they not only testify the product quality in a way, but also enable viewers to make their own judgment about product reputation.

Folksonomy (tag reputation): Tagging, one of the signature applications of Web 2.0 (Vander Wal, 2005), has also been incorporated in the reputation system of Amazon. Along with each product information, Amazon designates an area to allow members to tag the item according to their own definition/classification. Just like a typical tagging system, Amazon not only lists all the tags that have been associated with this particular product by other customers, but also displays the Amazon "tag cloud", with the highlighted labels being the most popular and most current tags.

As illustrated in a tag list, the number of members who have been using the same label to tag a particular product is displayed to indicate the product-specific tag reputation, which could be viewed as the relevance of the tag to a particular product. Under this context, the tag reputation may indirectly infer product reputation. For example, more customers tag a particular product indicates that more people could be interested in it.

The tag cloud, however, visually displays the tag popularity - a different type of reputation measured by how many times a particular tag has been used to label products in Amazon. Since tags play rather important role in forming customer communities, the tag cloud visualizes and compares the popularity of different communities.

Reviewer centered system: The past Amazon reputation systems are primarily product centered as it targets products being sold. Reputation scores in the pre-Web 2.0 Amazon reputation system are primarily about how good the products is to the customers. As Web 2.0 movement emerges, Amazon has seriously expanded its reputation system to embrace reviewers' reputation. The reviewer's profile now is displayed along each review he or she made. Reviewers are ranked based on three factors: the quality of the review, the correctness of the review, and total number of reviews the reviewer has contributed. In Amazon's current reputation system, the quality of the review plays the biggest role in determining the reviewer ranking. The quality of the review is primarily measured by how many members have voted the review as "being helpful," which is displayed at the end of each review, readers of the review may easily click on "yes" or "no" button to voice their votes. In other words, Amazon partially relies on a simple voting based reputation system to evaluate reviewer reputation, beyond that, the more reviews a reviewer contribute, the more likely he/she will be ranked higher in Amazon's "top reviewer list".

Other than using a number indicating the reviewer ranking, Amazon also rewards reviewers with various "badges" to signify different contributions they made to the community. Apparently, "Top 10 Reviewer" badge highlights the

reviewer reputation as being top ranked; the "Real Name" badge indicates that the reviewer's name matches his/her real world identity – the same name as the one on his/her credit card; and the "Community Forum 04" badge recognizes the reviewer as one of the participants in the 2004 Community Forum at Amazon.com corporate headquarters in Seattle, WA. Even though the last two badges may not be review related per se, they are important aspects that potentially help reviewers to establish their credibility. These practices provide different means for customers to earn their reputation and be recognized at Amazon, which in turn serves as incentives in motivating increased participation in Amazon community.

Community contribution: Since product tags can serve as effective intermediary to connect products and people who are interested in them, Amazon uses tags to form communities. In other words, each community is named after a popular tag. For example, the URL to a community named "photography", is displayed as: http://amazon.com/tag/photography.

At Amazon, a community consists of all the products that have been tagged with its name, the people who contributed those tags, the discussions initiated within the community, the product "Lists and Guides" recommendation created by community members, and images uploaded by community members. A typical community profile not only lists the number of customers, the number of products and the number of discussions in the community, it also indicates when the last time any activity happened in this community is. All these numbers in combination informs viewers about the reputation of this community. In this case, a multifaceted measure, rather than a single measure is used to indicate the community reputation. In addition, we observe that Amazon tends to include easy-to-collect, implicit measures such as the number of customers to evaluate the community reputation.

Besides, product tagging also helps Amazon to connect like-minded customers into community of practices, where members share product knowledge and help each other solve problems through reviews, discussion forums, and comments. These communication channels also allow customers to interact with each other beyond the initial purchasing of the product. For example, forum discussions may address questions like how to use the product effectively, or which accessories are necessary etc, extending Amazon services to include the post purchase education and support, resulting increased customer satisfaction. Notice this online community building effort may help connect Amazon customers offline as well. To promote its famed Kindle 2 ebook reader, Amazon created the "See a Kindle in Your City" campaign, the discussion forum help a potential customer who is interested in buying a Kindle device to locate a Kindle owner at their local community, so that the potential buyer may get a chance to see the device in person before making the purchase decision.

Comprehensive reputation: Amazon's Web 2.0 reputation system measures reputation for every contribution from any member today. Reputation serves as an important incentive for user participation in Web 2.0. What we see is that reputation system permeates every aspect of Amazon.com. As discussed earlier, Amazon provides various opportunities for customers to participate, from less intimidating ones, such as tagging a product, to more daunting ones, such as writing a guide about how to do bird photography. Amazon not only records every contribution that any member ever made, but also measures and publishes reputations associated with all contributions/activities. In other words, Amazon takes full advantage of reputation system, specifically, every tag, every review, every discussion, every images, every lists and guides that is contributed by customers is with reputation attached. In most cases, not only reputations of different contributions are measured differently, but also multi-dimensional measures are developed to evaluate specific reputations. We also see the increased use of implicit measures such as how many users have read the product guide, etc. Ultimately, the reputation of a contributor is sum of the reputations of all the contributions he/she made.

Dynamic and interactive system: Amazon's reputation system allows members to revise their feedback if they make a mistake. This feature is particularly helpful when the member's experiences with using the product change over time, and would like to reflect those changes in his/her review. Amazon's reputation system also includes a discussion forum where reviewers can comment on the other reviewers' post. Readers thus can easily easily voice their agreement / disagreement with a reviewer, adding additional product information, or ask the reviewer additional questions concerning the product. They can even invite other customers who share similar interests about the product to join the conversation. The discussion amonger members tune up the reputation initially generated by a reviewer and form a collective view of the product.

CONCLUSION

Web 2.0 has transformed how reputation systems are designed and used by the Web. Using latest Amazon's reputation system as a case, this paper attempts to investigate the impacts of Web 2.0 principals on reputation systems. From Amazon's newer reputation systems, the paper notes several distinguished features. These new developments reflect Web 2.0 design principals and promise a path that move towards a trustworthy and reliable online reputation system in the future. While our observation is limited to a single case only, the practice of Amazon gives insights for further investigation of online reputation systems in Web 2.0 era. Further researches in this area is clearly needed and likely very productive.

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