

# Measuring Node Importance and its Impact in Consumer Networks

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## ABSTRACT

Consumers have self-organized into virtual brand communities. These communities can be modeled as two distinct, albeit connected, networks: social and informational. These networks change over time as product involvement and its resulting word-of-mouth change. This study introduces a new metric for measuring network node importance and uses that metric to empirically support a model explaining how these community networks change over time by observing the evolution of ten diverse online brand communities. These communities are egalitarian in assigning value to informational content. Highly-valued content explains 10% of social network growth while product involvement seems to explain the remainder.

## Categories and Subject Descriptors

J.J.4 [Social and Behavioral Sciences]: Economics.

## General Terms

Algorithms, Measurement, Economics.

## Keywords

Virtual community, word-of-mouth.

## 1. INTRODUCTION

Part of a consumer's enjoyment of a product is talking about it, especially to people that also enjoy the same product, in a phenomenon called *word-of-mouth*. Since it is sometimes difficult to find fellow product users virtual communities, such as chat rooms, message boards and *blogs* (*weblogs*), have emerged to unite people with similar interests who would probably never meet in the physical world. In these communities people create ties to other people with the exchange of units of discourse that link to create an information network while the people create a social network (figure 1). Over time the information network becomes a vast body of knowledge that new community members may wish to search. It is valuable to be able to find the information that has been of most value to the community and identify any members that have been the source of the most valued information. As a result, this paper proposes a new metric that measures importance in the information and social networks and uses this metric to investigate the impact highly-valued information has on member involvement in the networked community.

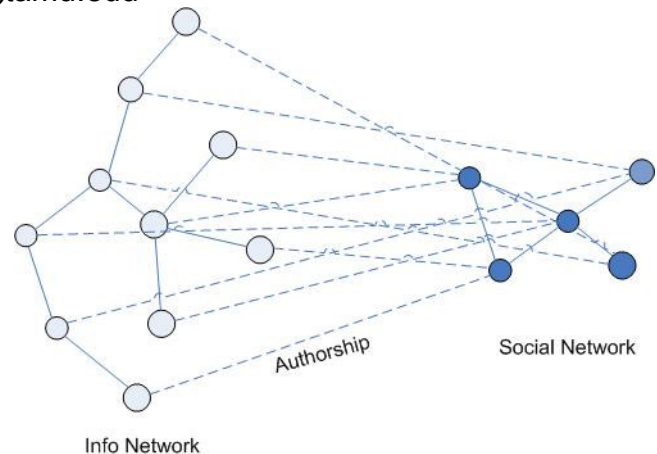


Figure 1: Virtual Community as a Dual Network

## 2. PURPOSE

This study proposes the model of figure 2 to show how waxing and waning product involvement is responsible for the growth and decay (eventual demise) of product-oriented online communities. The first phase of this study validates a metric derived from Google's PageRank™ algorithm for listing the websites returned from a search in decreasing order of popularity. This adapted PageRank™ (APR) metric is proposed as a better measure of information and social network importance (social capital) than the prevalent metric based on centrality (number of direct ties).

This study is designed to demonstrate a practical difference between the two metrics by showing how they answer a question concerning the central influence in preferential attachment: Is preferential attachment driven by homophily or superior expertise? In so doing, this study tests the hypothesis that the APR metric is merely a reflection of authored message volume and longevity of community participation rather than a measure of the community's appreciation of that participation. The second phase of this study uses the APR as a measure of knowledge capital to determine the role highly-valued content in the informational network has in opposing decay in the social network.

## 3. DATA SOURCE

The archives of ten product-oriented Yahoo™ groups were used to construct the social and information networks studied. The Yahoo™ archives indicate the author of each message and the thread hierarchy of messages and their replies. This allows a knowledge network for each group to be constructed in addition to a social network between authors. These groups were purposely selected to get large, highly active groups with wide diversity in their underlying subject matter and large volumes of messages.

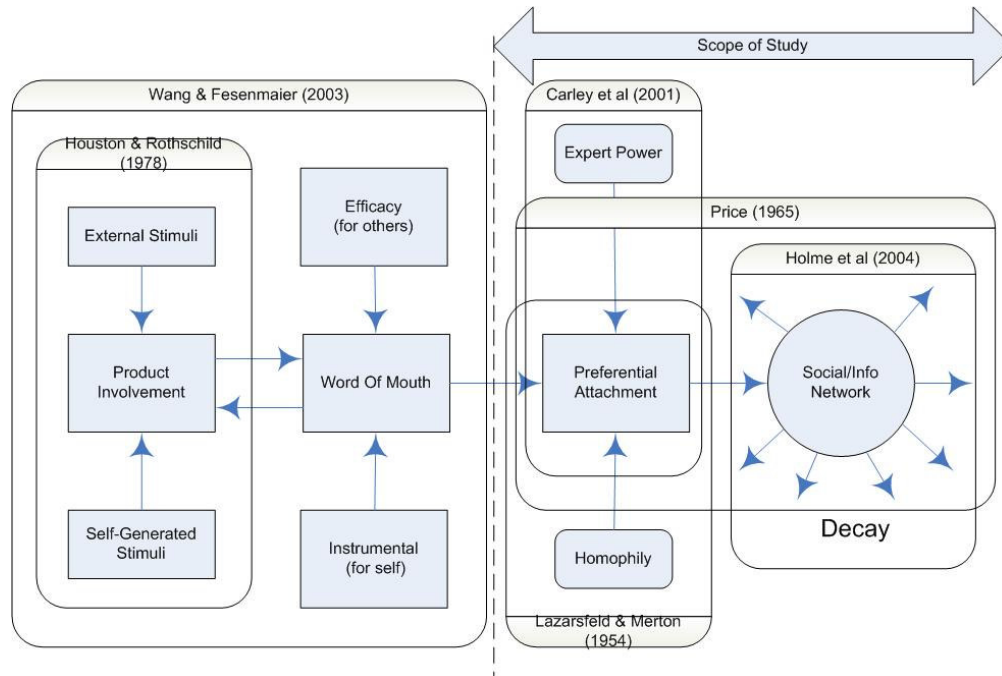


Figure 2: Conceptual Model of Consumer Network Dynamics

#### 4. METHODOLOGY

The analyses used in this study use Glymour et al's (1987) methodology for *directed acyclic graphs (DAGs)*. This methodology uses the correlation between variables and any knowledge of temporal relationships to construct a diagram of nodes, representing variables, and arcs, representing causal dependency among the variables. These diagrams must then be compared with known theory as a litmus test for their validity. Once such a diagram has been accepted as theoretically correct then the same techniques used to calculate parameter values and fit in *structural equation models* can be used.

#### 5. FINDINGS

The PageRank™-based algorithm is a superior basis for measuring importance in the informational and social networks than the prevalent centrality-based metrics. Content of high value to the community attracts attention with little reference to who originated the content. Thus superior expertise or what Carley et al (2001) call *expert power*, in whatever form is respected by the community, is the prime influence in how the knowledge network causes the social network to evolve over time. High-value content in the knowledge network explains 10% of social network growth. Changes in people's enjoyment of the products they would logically account for a large part of the network changes my model has not explained. Validating this supposition would be a logical avenue for further research.

#### 6. ACKNOWLEDGMENTS

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