Separating the Wheat from the Chaff: Evaluating Success Determinants for Online Q&A Communities

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Abstract

Researchers and community managers try to measure the success of online communities using a variety of success determinants, such as member activity, turnover and interaction. Although many success determinants have been proposed in the literature, it remains largely unclear which are applicable to which kind of online communities. In this work, we focus on the use case of question answering (Q&A) communities, where we can measure *asker satisfaction* as an aspect of community success towards the goal of solving questions. We evaluate how well the proposed success determinants correlate to asker satisfaction, and we find that less than half of them are at least moderately (± 0.3 or more) correlated. That underlines the importance of evaluating the proposed success determinants on real data of specific community types.

1 Introduction

Businesses and non-commercial groups have recognised the importance of well functioning online communities for revenue, knowledge sharing and support. Communities that do not function well can be frustrating for their members, e.g. by ignoring their requests, which in turn can affect the communities' continuity and success. DeLone and McLean (1992) formalised success factors for information systems, such as user satisfaction and impact. Others proposed success determinants which could indicate whether or not a community is fulfilling its purpose socially as well as technically (Preece 2001), or towards concrete goals throughout different stages of a community's life cycle, such as integration of new members (Iriberri and Leroy 2009). However, these goals are often not directly measurable, and the relation between the success determinants and the achievement of the goals has not been proven by objective measures.

This research investigates success determinants for online Q&A communities, which are not only a popular type of support communities, but also record the process as well as the result of the sought support: the questions, the responding answers, and whether the asker is satisfied with the solution (Liu et al. 2008). From this, we can measure the community's Q&A performance, and derive its success towards its goal of solving questions. For our analysis of success determinants for Q&A communities, we define two metrics of *asker satisfaction* based on the number of successfully solved questions (Section 3), and then collect success determinants from the literature (Section 4) in order to examine their correlation with asker satisfaction (Section 5).

2 Related Work

In the early 1990's, before the rise of Web 2.0 and social networks, DeLone and McLean (1992) devised a conceptual model to formalise aspects of success of information systems, such as user satisfaction and impact on the individual and organisation. In order to further refine community success, Preece (2001) asked "Success for who?", and identified the perspectives of different stakeholders, as well as community goals and purposes. She discussed the importance of perspective, and mentioned business managers (representing a company), community managers, and community members. The companies and organisations intend to increase their revenue, e.g. by reducing monetary and time costs (DeLone and McLean 1992), improving product quality (Ransbotham and Kane 2011), or raising brand awareness and loyalty (Koh and Kim 2004). On the other hand, for communities that are owned by a non-commercial entity, e.g. for healthcare support, visibility and cost-effectiveness might not have priority. In this case, user engagement, interactivity, and a community that is attractive to newcomers is important (Preece 2001), as well as having a lively and sustainable community (Raban et al. 2010).

For moderators, a community would be successful where the users behave according to the social rules and policies (Cheng et al. 2015) and integrate newcomers well (Iriberri and Leroy 2009). Finally, the community members themselves are an essential group of stakeholders, so the satisfaction of their aims has high priority for retaining an active user base (Sangwan 2005). That can include the provision of high quality and quantity of content (Ransbotham and Kane 2011), the facilitation of professional development (Hew 2009), or a maintenance of social interactions through a vivid interaction among the users (Wagner et al. 2014).

The success of an online community does not only depend on the people who want to benefit from it, but also on the purpose of the community. For example, an interest-based community must provide an environment where people can openly and transparently participate in discussions about the topic of interest, and might aim for tangible im-

pact in the field of interest (Budd et al. 2015). In knowledge-creation and other crowd-sourcing communities, the quality and quantity of generated content is vital (Qin et al. 2014). Similarly, software development communities aim for a high quality and functionality of the produced software, with a focus on timeliness because of milestone deadlines (Choetkiertikul et al.). In our work, we focus on Q&A communities, whose primary purpose is to provide information seekers with a platform for their questions, and with timely and accurate solutions (Hiscock et al. 2015).

The literature suggested many factors for community success, and while some articles make use of first-hand experiences by asking interviewees about their personal perception of community success (e.g. Leimeister et al. 2004), often these success determinants are not evaluated against objectively measurable success. In this work, we collect success determinants and evaluate them against two tangible success metrics for asker satisfaction in Q&A communities.

3 Asker Satisfaction Metrics

User satisfaction has been recognised as an important element to the success of online communities (Sangwan 2005). For Q&A communities, Liu et al. (2008) defined that information seekers are satisfied if their questions are sufficiently solved, which they indicate by explicitly selecting a best answer. According to this notion, we formalise the two metrics SQ and SQ_{time} for *asker satisfaction* as follows:

$\boldsymbol{SQ}$: Measures the proportion of solved questions for a community (Equation 2). In our data, communities solve 0% to 56% (SCN, see Section 5.1), and 17% to 78% (SE).

$$S = \{q : q \in Q, q \text{ has an accepted answer}\} \tag{1}$$

$$SQ = \frac{|S|}{|Q|} \tag{2}$$

$\boldsymbol{SQ_{time}}$: A short response time is also important (Hiscock et al. 2015). We weight SQ with $t_{solving}$, the average time it takes to solve questions (in hours), as per Equation 3. Because of the skewed distribution of solving times (between 20 minutes and half a year), we apply a natural logarithm to dampen the impact of extreme values. The time parameter $t_{solving}$ is only defined for solved questions, and is 0 if there are no solved questions in the community ($S = \emptyset$).

$$SQ_{time} = \frac{SQ}{ln(t_{solving} + 1) + 1} \tag{3}$$

4 Q&A Community Success Determinants

Although community success is difficult to measure, Preece (2001) used the term "success determinants" to describe indicators for success. Some of them are not straightforward to obtain, like unregistered visitors (lurkers) and social gratification. Hence, we limit our evaluation to success determinants that are based on information available in the data.

User attraction and retention The continuing growth and influx of new users is an important factor for a successful community (Johri et al. 2011), while at the same time users are constantly leaving (Ransbotham and Kane 2011). The churn of highly influential participants is especially dramatic and harmful to the community (Qin et al. 2014). The resulting net size (Toral et al. 2009) indicates whether a critical mass of participants is achieved (Raban et al. 2010). The age of a community was suggested to indicate how successful a community is (Xu et al. 2013), as unsuccessful communities are expected to diminish and die sooner than later.

- Community age: The time between the first and last recorded community post in the resolution of seconds
- Community size: Total number of users
- Community growth: Newly joined users per day
- User churn: The average monthly ratio between users who have posted for the last time in the data and users who will continue posting in later months
- VIP churn: Proportion of top-10% contributors leaving the community, averaged over all months

User activity A high user engagement indicates a successful community, which can be measured in the total number of posts (Preece 2001) and posts per day (Johri et al. 2011), as well as the number of posts per user (Wagner et al. 2014) and the number of contributors or answerers (Toral et al. 2009). Toral et al. (2009) also stated that a good amount of new threads or questions is required for a successful community, as they enable user engagement in the first place, and analogue threads or questions per day (Johri et al. 2011).

- Number of posts: Questions and answers in total
- Number of questions: Number of questions; matches the number of threads in other community types
- Posts per day: Number of total posts divided by the number of days the community has been active
- Questions per day: Number of questions divided by the community age in days
- Posts per user: Questions and answers per user
- Number of answerers: People who write answers

User interaction The number of posts per thread or thread length, and the number of unique users per thread (Wang and Lantzy 2011) are measures for interactivity between users, where a high interaction is considered beneficial for the community. In that respect, reciprocity is the relation between giving to and taking from the community, and can be measured by the number of questions that received answers (Wang and Lantzy 2011), or that were ignored (Wagner et al. 2014), as well as the ratio between the two (Rowe and Alani 2012). Also measures of reciprocity are response time (Wang and Lantzy 2011) and the ratio of questions and answers per user (Preece 2001). The network density and connectedness between users (Qin et al. 2014; Rowe and Alani 2012) can indicate a well-functioning community because users benefit from a high information flow between them.

- Number of seed posts: Number of questions that received at least one reply from another person
- Number of non-seed posts: Ignored questions
- Seed/non-seed ratio: Questions with at least one answer divided by the number of ignored questions
- Thread length: Average number of posts in a thread

Success determinant	SQ		SQ_{time}		Reference
User attraction & retention	**SE**	**SCN**	**SE**	**SCN**	
Community age	** 0.25	0.12	-0.01	0.02	Xu 2013
Community size	0.09	0.09	0.04	0.10	Preece 2001; Toral 2009; Rowe 2012; Xu 2013; Wagner 2014
Community growth	0.08	0.08	0.04	0.11	Johri 2011; Wagner 2014
User churn	*** -0.45	-0.36 ***	** -0.25	-0.28 **	Ransbotham 2011; Rowe 2012; Qin 2014
VIP churn	*** -0.46	-0.34 ***	** -0.24	-0.27 **	Qin 2014
User activity					
Number of posts	0.09	0.20 *	0.05	0.22 *	Preece 2001; Wang 2011; Xu 2013; Wagner 2014
Number of questions	0.09	0.18	0.05	0.19	Toral 2009; Wagner 2014
Posts per day	0.09	0.20 *	0.05	0.23 *	Preece 2001; Johri 2011
Questions per day	0.09	0.17	0.05	0.20	Johri 2011
Posts per user	*** 0.37	0.52 ***	*** 0.38	0.46 ***	Preece 2001; Wagner 2014
Number of answerers	0.09	0.12	0.04	0.13	Toral 2009
User interaction					
Number of seed posts	0.09	0.21 *	0.05	0.22 *	Wang 2011
Number of non-seed posts	0.08	-0.05	0.04	-0.03	Wagner 2014
Seed/non-seed ratio	*** 0.32	0.75 ***	*** 0.44	0.68 ***	Rowe 2012
Thread length	*** 0.38	0.60 ***	*** 0.34	0.57 ***	Preece 2001; Wang 2011; Wagner 2014
Unique users per thread	*** 0.40	0.42 ***	*** 0.37	0.51 ***	Wang 2011; Wagner 2014
Reply effort	*** 0.28	0.18	*** 0.28	0.25 *	Preece 2001
Response time	-0.04	-0.54 ***	*** -0.31	-0.34 ***	Wang 2011
Network density	*** 0.29	0.41 ***	*** 0.41	0.33 **	Rowe 2012; Qin 2014
Content creation					
Content length	0.00	-0.25 *	-0.05	-0.29 **	Preece 2001
URLs in posts	*** -0.32	-0.27 **	*** -0.41	-0.12	Wagner 2014

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$

Table 1: The correlations between success determinants and our asker satisfaction metrics SQ and SQ_{time} show that only few of the determinants have a high impact on Q&A community success. For brevity, the references show only the first author.

- Unique users per thread: Average number of distinct users that participate in a thread
- Reply effort: Per-user average of contributed answers divided by all their posts (questions + answers)
- Response time: Average time between the posed question and the arrival of answers in seconds
- Network density: Average local clustering coefficient between the users who answer each other's questions

Content creation Finally, the quality of questions and answers shows how motivated users are, which is a sign of success. Preece (2001) considered the message length a measure of content quality. Also, references to internal and external sources can indicate user effort (Wagner et al. 2014).

- Content length: Average number of words per post
- URLs in posts: The proportion of posts that contain at least one reference to internal or external sources

5 Evaluation

In this section, we investigate how well the proposed success determinants reflect asker satisfaction in Q&A communities.

5.1 Data Description

We focus on Q&A communities because of their clearly defined goal of solving questions. Stack Exchange (SE, stackexchange.com) is a popular multi-purpose Q&A site for hobbyists and professionals, where members discuss anything from cooking to software-related questions. We downloaded the publicly available data dump from June 2016, which contains 8 years of data in 152 forums. The SAP Community Network (SCN, scn.sap.com) is a corporate Q&A platform, where members discuss technical questions revolving around SAP's software products. The SCN data is dated from 2003 to 2011, and contains 95 forums. It was made available to us as part of the EU project ROBUST (robust-project.eu). Similar to existing literature, we refer to the forums in the data as communities, each one discussing a specific topic (e.g. Toral et al. 2009; Rowe and Alani 2012).

5.2 Correlation Analysis

In Table 1, we list the Pearson correlation between each individual community success determinant and the two metrics for asker satisfaction SQ and SQ_{time}.

Well Correlated Factors At first glance, we see that very few of the investigated success determinants have a high correlation (± 0.5 or over), where the highest correlation of 0.75 is achieved by the seed/non-seed ratio on the SCN data. That is not surprising, as questions that are ignored and receive no answers cannot be solved in the first place. Similarly, thread length, the number of unique users per thread, and the number of posts per user show good correlation in some cases, confirming that the probability to solve a question rises with the number of answers and the number of involved users. Among the other factors that show acceptable correlation are user churn (and very much the same VIP churn), as well as network density. The relation of these factors to asker satisfaction is not as obvious as the factors related to the answer

rate, but in general, the interconnectedness between people has a positive effect on Q&A success, as much as churn-related factors have a negative impact, which confirms these suggestions from the literature. The surprise of the impactful factors is that URLs have a negative (but significant) effect on asker satisfaction instead of a positive one. We would expect that provided references increase the chance of satisfactorily solved questions, but the results show otherwise.

Poorly Correlated Factors Some of the success factors that were proposed in the literature have a very low or no significant correlation to asker satisfaction. Among them are factors that describe community size and growth: the number of posts, questions, users, and their creation or join rate per day. There is a simple explanation for their irrelevance: Although they are popular success determinants in the literature, smaller communities can be just as successful as their bigger counterparts. If we imagine a Q&A community as a (simplified) producer-consumer system, then its success depends to a big degree on its *ratio* between supply and demand of answers, rather than on the raw numbers of supply and demand. In contrast to the existence of URLs, content length is completely irrelevant for asker satisfaction.

6 Conclusions and Future Work

In this work, we investigate how well community success determinants that were proposed in the literature are related to asker satisfaction, an aspect of community success that is specific to Q&A communities. Based on the proportion of solved questions, we define SQ and SQ_{time} as tangible asker satisfaction metrics, of which SQ proves to be better correlated with the success determinants. From the proposed determinants, the majority show little correlation (± 0.3 or less) with asker satisfaction. This shows that it is important to carefully select the most viable success determinants, as not every proposed user activity measure is a real determinant of success. The most impactful success determinants are related to the number of answers per question, the number of posts per user, and the loyalty of and interconnectedness between the users. Other proposed determinants show no or little correlation, such as the age, size and growth of the community, as well as content length. It is noteworthy that some of the determinants with no direct affect on the number of answers per question and thus on the solving probability, such as network density, user churn and a lack of URLs, are indeed related to Q&A community success.

One potential future direction is to investigate the viability of the success determinants by predicting community success on other types of online communities in social media. We also want to study more complex as well as not directly measurable factors that influence the success of online communities, such as question difficulty, community development over time, user interface, and trust.

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