Analysis of Software Service Usage in Healthcare Communication Services

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1. Motivation

In secure healthcare communications, there are two dimensions of quality: (1) quality of the software (functional and non-functional), and (2) quality of the network/community (participants and volume of interactions). We believe in order to find an equilibrium and efficiently deploy scarce resources, we must analyze quality with respect to system utilization. Optimizing service portfolios based on usage is not specific to Software As A Service (SaaS) products, like those offered in healthcare solutions, and applies to any product release offering a selection of sub-features [1]. Feature usage analysis becomes an important factor in SaaS products in healthcare due to the strong tie between usage and revenue. If the financial model is transaction based, then revenue is directly generated with each service usage; but if subscription based, it is influenced by service usage. In both cases, revenue relies on the users [2], [3]. Feature usage monitoring has proven to be a good quantitative approach to discover customers′ percieved feature value [4], [5]. The imbalance in feature usage is the primary reason this area is so important. Results show that 80% of overall usage comes from only 20% of available features, leading to increases in maintenance effort and cost with little ROI [6]. As Vinod Khosla described the importance of data science, ”in the next ten years, data sciences and software will do more for medicine than all of the biological sciences together” [7].

2. Context

Brightsquid Secure Communication Corp is a global provider of health communication systems - providing email services for medical and dental professionals since 2009. Customers are broken into two types, patients and practitioners. Services offered create a secure bridge between patients and practitioners, as well as amongst practitioners, and allows them to have direct contact (i.e. lab results, appointments). We explore the relationship between customer experience, system quality, and system utilization. Service usage acts as our dependent variable, and we aim to find the impact and severity of change on system usage. JIRA is a bug-tracking software used by Brightsquid to monitor bugs, track incoming requests, and allocate resources for implementation and bug-fixes. The independent variables include: (1) number of closed and opened JIRA tickets per release, and (2) service usage per release. Product releases are directly linked to how much change is experienced. Thus, product releases are a good baseline to analyze impact of change on customer behavior and system usage. Data collected for each release includes records for message activities, number of accepted invitations, overall product usage (from Google Analytics), and number of JIRA tickets.

3. Results

3.1. Impact of Maintenance on Product Usage

To measure influence of software maintenance on system usage, we have extracted total number of JIRA tickets opened (recently opened, reopened, or in-progress) and closed during each product release. Open tickets measure total effort required in terms of bug-fixes or improvements during the next release cycle. Similarly, closed JIRA tickets show effort spent during the current release cycle.

RQ1: How does the degree of closed tickets influence system usage? **Hypothesis**: Closure of more JIRA tickets in a release results in more usage in upcoming releases.

In the healthcare realm, software quality has an objective non-functional dimension. focusing on performance, reliability, and security/privacy. Whereas subjective business functional requirements are driven by customer needs, service values, and benefits to the healthcare domain. JIRA tickets reflect both functional and non-functional requirement as they address issues generated from those areas. Figure 1 shows the difference between closed and open JIRA tickets during each release *(R1 to R6)*, and the impact of bug fixes and improvements on system usage. SaaS businesses want to optimize the release cycle duration to maximize system usage in either subscriber-based or transaction-based systems. Results show, whenever there are more JIRA tickets being closed than opened during a release (and at higher rates), system usage is increasing at the same rate, with *R2* being an exception. Also, abrupt reductions in usage occur during releases that have higher lengths (Figure 2). This indicates that a threshold in release duration may exist where overall usage is optimal. However, some biases exist that cannot be ignored. Positive trends may appear when

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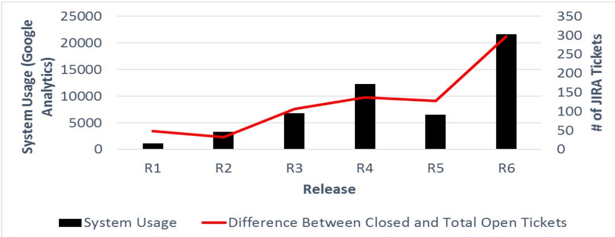

Figure 1. Impact of software maintenance effort on system usage.

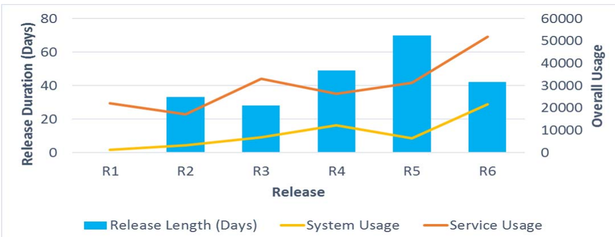

Figure 2. System usage versus release duration.

there are no incoming tickets while there are quality issues that are not reported.

3.2. Impact of Service Activities on Product Usage

To explore the relationship between service and system usage, we incorporated activity patterns during each release, extracting number of delivered messages and number of accepted invitations (for each customer type).

RQ2: How do different user segments perceive the healthiness of the code within every product release? **Hypothesis**: New releases drive acceptance for practitioners but not patients due to the high synergy between practitioners using the system on a regular basis.

Figure 3 shows that the correlation between invitations accepted by practitioners and the increase in messages sent to other practitioners is slightly higher than those for patients. We have used the Spearman's rank-order (rho) formula to measure the correlation. The rho correlation values are 0.95 and 0.85, respectively. Results show, activity between practitioners has a bigger impact on increases in system usage, with the exception of *R5*. This information can be used to optimize system usage growth by identifying users that are more likely to generate more activity, exploring whether a dependent versus independent relationship can be asserted between these users, and analyzing whether the synergy amongst practitioners is higher than those between practitioners-patients, its strength and how a balance can be achieved.

4. Related Work

Work in this field include detecting solutions for efficient SaaS and e-commiunications development (i.e. [1], [3]), data analytics and decision-making in software development (i.e. [1], [2], [6]), and feature usage analysis and product value estimation (i.e. [4], [5]). This study combines the empirical evidence from these areas to identify effective solutions to enhance customer experience and increase system utilization in health e-communication services.

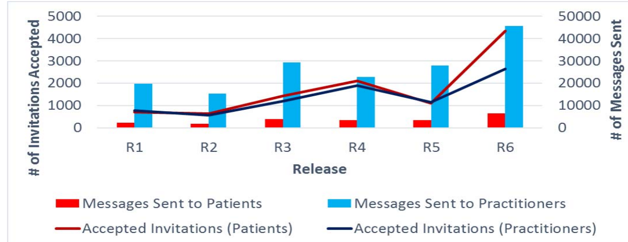

Figure 3. Service usage/activity triggers activities based on customer type.

5. Conclusions and Future Work

Service reliability, system quality, and service usage patterns have an impact on volume of system usage. Service usage can help us detect abnormalities in system utilization (i.e. *R5*). Incorporating content/type of releases may reveal causes and potential solutions to enhance customer experience and increase system utilization. Next, we will:

1) Analyze patterns in service usage by type and size.
2) Measure impact of release attributes like type (i.e. adapting, enhancive) on system utilization.
3) Use incoming JIRA tickets to find optimal strategies addressing user-specific needs per release.

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