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Modeling Utility in the West Point Mobile Application

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Author Note: Zachary Aloma, Albert Beninati, Shelby Haynes, William Huff, and Daniel Ko are all cadets at the United States Military Academy. Our responsibilities in the Corps of Cadets range from Platoon to Regimental positions and include Trust Officer, Logistics Officer, and Physical Development Officer. We are thankful for MAJ Stephen McCarthy, COL Cecil Marson, Dr. Katie Daily, and Debra Dalton for their support and guidance in this project.

Abstract: The purpose of this paper is to develop a general quantitative model to maximize the utility of mobile applications at academic institutions. Using specific team member areas of expertise including Mathematics, Systems Engineering, Operations Research, and Business Analytics, we used a holistic and interdisciplinary approach for model formulation. This paper uses previous and new research on the West Point Application to construct a utility model for the West Point community. By evaluating and quantifying the cumulative effects of application architecture, functionality, and marketing, the model can predict changes in behavior and benefit for West Point community users. Because a holistic approach was used, the tenants of this model are transferable to other applications within other similar university communities.

Keywords: Mobile Applications, Utility Model, Community

1. Introduction

The West Point App, introduced in 2018, was conceived as a means of providing relevant information to the West Point Community. Funded by the Dean of the Academic Board, this app was envisioned as a means of addressing noticeable lapses in the communication of events and critical information to the Corps of Cadets and larger West Point Community. While previous research groups worked to improve the infrastructure and functionality of the application, they were unable to gather data on application performance during its lifetime. As such, there was no way to measure the effectiveness of application modifications or feature additions. Through our primary stakeholders, we identified first, the short-term needs of additional features and second, the long term need to craft an application that provides the maximum benefit to the West Point Community. This long-term need was fulfilled by first understanding the functions that application users require and through collecting and analyzing data provided by the application's control software.

To understand overall utility and meet the functional requirements of application users, we designed a quantitative model that measures the effects of architecture, functionality, and marketing in the application. Key aspects of our problem-solving include identifying the populations within the West Point community and understanding what app features provide the most benefit to each of these populations (Functionality). Using application updates and trends in use over time, we determine which marketing strategies are the most effective (Marketing). Last, by understanding the use and value of each feature, we assess the overall construction of the application (Architecture). Quantifying utility through these three factors enables us to develop a strategy for overall application improvement with the result being an application that is used consistently by a growing number of users. Although the quantitative methods used center on a specific community at West Point, NY, the criteria established may be applied in a general sense to other mobile applications.

2. Problem Definition

While the West Point Mobile Application has been available to all mobile phone users for over two years, the West Point community has not adopted the app on a wide scale. Some gaps to usage include other wellness apps at West Point, such as LiveSafe and other means of communication, such as email. Our research aims to increase the use and utility of the West Point Application by improving functionality and awareness. We intend to develop a product that provides high utility to our

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four identified sub-populations of cadets, community, visitors, and parents to increase the user retainability. Subsequently, a rejuvenated West Point application that is widely marketed will encourage repeated use and reliance.

3. Functional Decomposition

The development of a functional hierarchy focused our research on the specific functions that a mobile application must accomplish for our four sub-populations. The fundamental objective of the application is to increase the utility of the West Point App. To achieve this, there are three functions that contribute to our primary objective (Figure 1). The application must be useful for the community: provide functionality; it must be widely known about: provide marketing; and it must have accessible, adaptable features: provide architecture.

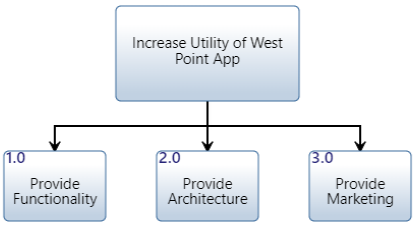

Figure 1. Functional Hierarchy

4. Model Formulation

Utility analysis must consider variance in the application, users and populations, and minimal available data. In order to use traditional methods in an untraditional environment, we adjusted the functional hierarchy to fit a quantitative model which simplifies the key aspects of analysis. This 'Utilization Funnel' considers Functionality, Architecture, and Marketing as key variables contributing to an application's overall utility. These variables describe the avenues to reach cadets, community, visitors, and parents. The utilization funnel was created to measure the changes in these major variables over the application's lifetime. Represented by the utilization value function, U = F + A + M, the funnel provides a holistic view of the app's utility and allows for subsequent determinations for the best methods for increasing utility and attracting users shown in Figure 2.

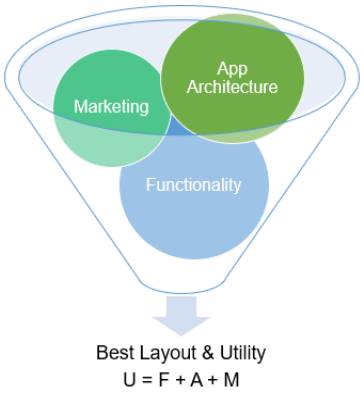

Figure 2. Utilization Funnel

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4.1 Explanation of Quantitative Model

This model describes the contribution of application components over time and provides a way to measure the overall utility of the West Point App. The model is intended to provide a quantitative means of examining the utility of an application during its lifetime with data that is readily accessible to development teams. In our case, this data was drastically limited, as the development platform only collects and provides data in the aggregate. Therefore, we were required to analyze our model's outputs in terms of comparisons to the baseline data that was collected during our tenure on the project. While this constricts the number of observations provided by our model, the overall insight provided by investigating these components is exceedingly important. Initial data collection began on January 11 and was used as a baseline for the regressions and analysis within the quantitative portion of the model. Prior to understanding the results provided by this quantitative model, it is important to further understand the components that drive its composition.

4.1.1 Functionality

On the surface, functionality can be understood as the measurement of benefits provided to the user. This represents a complex and integral measure of app performance as it is ultimately functionality that contributes to sustaining the overall use of the application. For a fully functional app, we desire to see continued usage from new and existing users as the app continues to develop. To model this component, we captured the 'activity patterns' within the app, measured by a ratio of users to total visits. The number of visits is the total, by device version, of times a user has activated and used the application. The number of users is simply the number of current devices that have downloaded and accessed the app at least once.

Functionality (F) = 1 - (Users : Visits Ratio) (1)

4.1.2 Architecture

The architecture of our application represents one of the most concrete and feasible uses of engineering within this model. This is a means of analyzing how the app presents information, and which features provide the most use to our users. This is quantified by collecting the sum of features in use and dividing them by the sum of all features. This is represented by features that account for less than 0.1% of overall application utilization. This was selected as a current benchmark for feature use as it represents that, in the specific observation period, that feature was engaged with. It is important to understand and analyze the usage of features within the app, as these patterns could suggest a lack of use for that function due to low utility or an inability for the user to locate it. This metric represents the various aspects of the construction of the application which include the main buttons, app graphics, and their organization.

Architecture (A) = sum(Features in Use) / sum(All Features) (2)

4.1.3 Marketing

Marketing is the component of utility that measures the overall visibility of the application to its intended audiences through various avenues of communication. The marketing score represents the overall impact of various methods of marketing employed throughout the course of our research. It is quantified by analyzing the ratio of new users of the application of the course of a month and an established goal amount for sustained growth through marketing campaigns. These alluded to efforts were a combination of outreach to departments within West Point, external articles and media posts, and notifications with the application.

Marketing (M) = Monthly User Change / 261 (3)

4.2 Model Analysis

In order to analyze the application's performance, it is imperative to first establish and describe the minimum, optimal, and maximum values for the various established components of utilization. The utilization model has a utility-scale of one to three, where three is the maximum utility. This is due to the scale and nature of the subcomponents which have various possibilities based on the available data. For Functionality, the scores will range from zero to one as the extremes are represented by either having no users and visits or having an equivalent number of users and visits (*both of which are highly infeasible*). For Architecture, the score will range from zero to one as the extremes are represented by either having no features in use or having all features in use. Lastly, our marketing score can range from zero to one as the extremes are represented by no growth in users and having steady, expected growth in users from our baseline estimate.

4.2.1 Preliminary Analysis

At our baseline analysis, we observed a total utility score of 2.32 for the application based on the summation of our three component scores. In order to understand this value, we need to observe the trends and equations that enabled us to arrive at this value.

4.2.2 Functionality

First, we will observe and analyze the initial functionality of our app to better understand how our users use the application. In Figure 3, you can see the positive trends for both users and visits throughout the course of a month of observation.

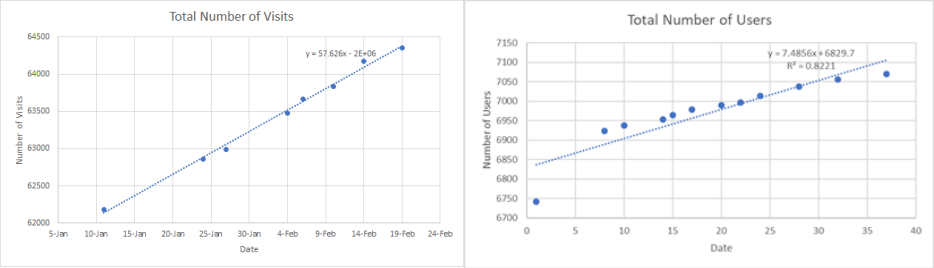

Figure 3. User and Visit Trends for the West Point App

From these depictions of the data, we can infer that both visits and users have experienced a positive trend of growth, though visits have shown a stronger and more defined trend. This can be largely accredited to greater advertisements to current user populations during this month. At our baseline, we observed a score of .89 for functionality. While this score stayed stagnant between the two months of analysis, it is an important indicator of how our app is in use at this period. In order to better understand the future implications of these trends on functionality, we ran a linear regression that predicts users and visits given the date.

$$Number\ of\ Users = 7.4856x - 6829.7 \quad (5)$$

$$Number\ of\ Visits = 57.626x \quad (6)$$

4.2.3 Architecture

For architecture, we decided to investigate the portions of the application that are currently in use and what portion of the use they accounted for. At our baseline analysis, we found that only 43% of the features were actively being used. This contributed .43 to the overall utility of the application. In Figure 4, it is shown how this use is split between the different active portions within the app currently.

This shows that the most used portions of the app are Mess Hall and Athletics features. This allows us to better understand how the app is currently used and how it is used by different populations. The major conclusions are that cadets and parents use the application most frequently for knowledge of West Point events Mess Hall meals. The features that have minimal use should be archived or moved to other locations within the app.

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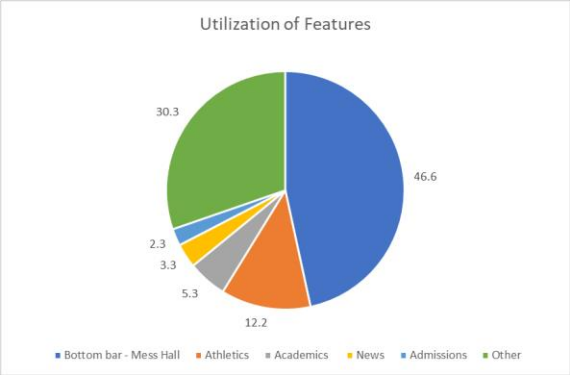
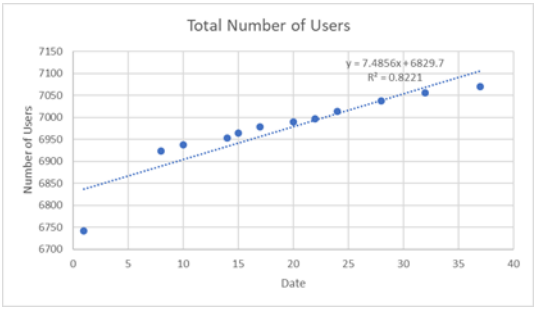


Figure 4. Overall Utilization of App Features

4.2.4 Marketing

The marketing ratio is an impact score that describes the relationship between the number of new users in a month over our expected number of new users in a month. Through our regression, we found that the baseline expected number of new users in a month was 261.2, which was a substantial user goal according to trends. In order to quantitatively measure the effects of our marketing strategy, we used the linear regression of the number of users. To quantify this data, we determined that 261.2 was an ideal number of users per month (Figure 5). From this, we can begin to better understand the necessary advertisement and growth of the app to maintain users. Implementing effective marketing methods that support our linear regression will allow the app to meet utilization and usage requirements.



Number of Users = 7.4856x + 6829.7

Figure 5. The Effects of Marketing Strategies

4.3 Findings and Conclusions

From observation and analysis gathered at the end of March, the utility of the app increased from 2.32 to 2.57 (Figure 6). We found that the value of functionality increased as more users utilized the app, and the value of app architecture increased by removing features that were not used. This analysis will continue to inform the changes we make to the app to improve its utility as we project further improvement to the app's architecture and functionality.

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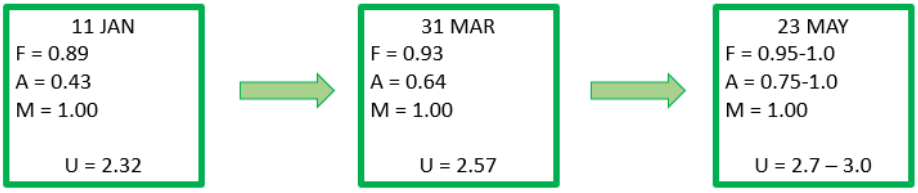

Figure 6. Utilization Funnel Quantitative Results

Through an elimination of unused features and a continuation of current marketing efforts, we can expect to see our model approach peak utility during the months of May or June. This is due to preliminary reports from our most recent event, Plebe Parent Weekend, which suggests that the utility of the app increases due to a greater demand for information. In the future, the application will generally possess the greatest utility during these periods, as they encourage increased use and foster a greater applicability for the application's functions.

Through engaging with the utilization funnel, we can begin to see the various components acting within the application and actively contributing to the utility provided to our consumers. As more data is collected, we will gain a better understanding of how newly implemented features and proposed changes affect the future utility of the app.

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