

Developing a Reliable and Economical Web Portal for Meals on Wheels
(Technical Topic)

Considerations When Developing Software for Multi-Generational User Groups
(STS Topic)

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On my honor as a University student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments.

Introduction

Food scarcity is a worldwide problem that manifests itself via several issues, including lack of food production, inefficiencies in distribution, and lack of mobility to obtain food. The USDA estimates that 1 in 8 American household are food insecure, meaning they have “difficulty in providing enough food for all of their members” (Feeding America, 2017, n.p.). While pervasive in all demographic groups, this issue continues to worsen as America’s population ages. Senior citizens are America’s “fastest-growing food insecure population” (Feeding America, 2017, n.p.). This growing need necessitates intervention from communities and organizations.

Locally, Meals on Wheels of Charlottesville is a nonprofit that helps mitigate this issue. They have over 400 active volunteers that deliver meals to over 200 recipients in and around Charlottesville. However, this comes with a high degree of operational complexity which necessitates management through an online web portal. The technical project outlined in this prospectus seeks to rebuild the existing web portal to improve functionality. The STS research will focus on the extent to which users should be engaged in the software development lifecycle to maximize adoption of new applications.

Technical Topic: Developing a Reliable and Economical Web Portal for Meals on Wheels

Despite America being one of the richest countries in the world, an estimated eight million of its aging citizens face the threat of hunger (World Bank, 2019, n.p.; NCOA, 2015, n.p.). Meals on Wheels is America’s oldest and largest organization dedicated to mitigating this issue through community chapters (MOWA, 2019, n.p.). The non-profit’s local chapter

delivers meals to disabled or elderly people in the Charlottesville-Albemarle area who cannot cook or buy food themselves. With the help of volunteers, the organization packs, labels, and distributes meals via various delivery routes to customers. In addition, volunteers drive a few shuttle routes to deliver meals to locations outside of the Charlottesville-Albemarle area (A. Dudley, personal communication, September 27, 2019).

A small team of three paid staff administers Charlottesville's Meals on Wheels chapter by managing delivery routes, maintaining current and prospective customer information, and ensuring that all daily jobs are filled by at least one volunteer (S. Bayker, personal communication, September 13, 2019). These administrative tasks can get rather complex due to a combination of daily, weekly, biweekly, monthly, and one-time volunteer shifts and customer needs. Also, most of the meals delivered are sourced via donation, which makes predicting supply difficult.

The greater US Meals on Wheels Organization sells professional software to help staff manage the complexity of their tasks; however, the Charlottesville office cannot afford it (A. Dudley, personal communication, October 11, 2019). Thus, staff managed volunteers, customers, and routes by hand until approximately three years ago, when a University of Virginia computer science capstone team created a web portal for them. Adopting this web portal gave Meals on Wheels' staff more time to focus on essential tasks by automating physical reports and tedious manual tasks.

A subsequent capstone team updated the web portal to its current state, but Meals on Wheels' staff still desires improvements. First, the staff have complained that the web application has become increasingly slow over time. After examining the current codebase, we believe this slowness is likely due to its cluttered, unclear data storage and the use of an

inexpensive hosting solution. Second, they have identified several organizational oddities within the app layout, making some tasks take longer than necessary. Finally, they have requested the addition of new features, including historical report generation and general search functionality.

It is clear that the system needs an update; however, the technical debt¹ accumulated by the separate capstone teams developing features over a two-year period, necessitates a rewrite. Our capstone team's goal, therefore, is to write a new application that satisfies Meals on Wheels' needs and has a more reasonable and maintainable backend for long-term deployment, including state-of-the-art modularity via Docker, normalized² database models, and cost-effective cloud deployment via Amazon Web Services. By redesigning and modernizing from the ground up, our project should enable Meals on Wheels to operate at lower costs and function more quickly; the organization should have more time and money to help customers in need. We aim to provide a minimum viable product including features such as account creation, assigning volunteers to routes, and volunteer substitution by the end of the 2019. We plan to release the complete, working product by May 2020.

Requirements for a Minimum Viable Product

- All Users
 - As a user, I should be able to create my own account (including custom username), so I can log in and see personalized information

¹ According to Allman (2012), technical debt is “when engineers take shortcuts that fall short of best practice.”

² Normalization is the process of organizing a database to eliminate redundancy and inconsistent dependency. (Microsoft, 2017)

- As a user, I should be able to request to change my password in case I forget it.
- Volunteers
 - As a volunteer, I should be able to release my route on a day, so someone else can substitute for that job.
 - As a volunteer, I should be able to pick up a released route on a particular day, so no routes go without a volunteer.
 - As a volunteer, I should be able to pick up a new route that has not been previously assigned, so I can plan my hours in advance.
- Staff
 - As staff, I should be able to create clients, so I can accommodate a growing client base.
 - As staff, I should be able to generate reports, so I can prepare daily operations.
 - As staff, I should be able to manually create delivery routes, so I can customize the volunteer's tasks.
 - As staff, I should be able to manually delete delivery routes, so I can avoid cluttering the portal with unused routes.
 - As staff, I should be able to assign volunteers to recurring routes, so I can plan delivery.
 - As staff, I should be able to substitute volunteers for jobs, so I can ensure that all necessary jobs are filled.
 - As staff, I should be able to release volunteers from their recurring routes, so I can assign another volunteer to the recurring route.
 - As staff, I should be able to one-time release volunteers from their routes, so I can allow other volunteers to substitute.
 - As staff, I should be able to print reports that have been generated by any staff, so can have physical report copies.
 - As staff, I should be able to see who is volunteering on a particular day, so I can stay organized and communicate as necessary.

STS Topic: Considerations When Developing Software for Multi-Generational User Groups

The web portal will have two very distinct user groups: the employees of Meals on Wheels and the volunteers. The exact demographic makeup of the volunteer group is unknown, but a large percentage are known to be senior citizens (A. Dudley, personal communication, September 27, 2019). This distinct user group brings about several challenges that must be considered during development, including optimizing usability and preventing overcomplications that may limit adoption. In addition to determining the demographic information of the volunteers, it will be necessary to determine what portion of volunteers currently use this web portal, which has not been investigated.

Adoption rates of new technology among senior citizens can vary widely. For example, roughly 2/3 of senior citizens now own a smartphone (Poushter, 2017, n.p.). However, other factors, such as household income, can greatly reduce the likelihood of smartphone ownership. While tech adoption rates are rising steadily, senior citizens still “remain largely disconnected from the digital revolution,” especially when compared to other demographic groups. Additionally, “different types of older adults were likely to have different types of (dis)engagement with the Internet” (Dursen, 2015, p. 12). Thus, treating all elderly users as one homogenous group may prove unsuccessful since “gender, age, education, household composition and attitude towards the Internet” affect use and adoption rates among new digital technology.

Further research identifies specific usability challenges that senior citizens face when interacting with digital media, including small font sizes, challenging interfaces, and a

general sentiment of exclusion from online content. Sentiments that the online world was “created with someone very different than me in mind” are pervasive among senior citizens (Kane, 2019, n.p.). Thus, our team must keep all users in mind during the creation of this application.

Due to the specific needs of this user group, it seems necessary to engage the users during the design of the application. However, user-centered design brings about many challenges, including slower development times and contradicting inputs. Some studies have shown that user-oriented software design was directly related to “low overall success, few innovations, little flexibility, low team effectiveness, and low changeability of the software” (Heinbokel, 1996, p. 232). The challenge will therefore be identifying and *anticipating* the needs of the users as the software is being designed.

One additional technique when designing software for users with nuanced needs involves thinking in terms of operational profiles³. This method revolves around characterizations of how an application may be used, including identifying the key features, the pages that users interact most with, etc. Overall, this increases productivity during development by “allocating development resources to function on the basis of use” and spending time on the portions of the application that users deem most critical (Musa, 1993, p. 16).

When analyzing systems that must balance the needs of multiple stakeholders, it is helpful to think in terms of a framework such as actor network theory (ANT), initially outlined by Bruno Latour, among other scholars. Latour’s “Where Are the Missing Masses?

³ According to the UC Boulder Department of Computer Science, an operational profile consists of “independent operations that a software system performs and their associated probabilities.”

The Sociology of a Few Mundane Artifacts” provides a framework for weighing the benefit of various artifacts in everyday life. Techniques outlined in this paper allow for a greater understanding of technological development, which does not exist in a vacuum.

Thus, my work will focus on more accurately capturing the demographic makeup of the users of this portal and identifying their unique needs. Specifically, I will build on previous work by Heinbokel on user-centered design to understand the extent to which users should be engaged in the software design lifecycle to maximize their adoption of new applications.

Conclusion

In order to improve the operational efficiency of Meals on Wheels of Charlottesville, my capstone group will create a web portal that allows staff to manage the operational complexity of the organization, including managing volunteer and customer data, delivery schedules, and routes. This new software will replace the current portal, which no longer meets the minimum needs of the organization. Additionally, my STS research will focus on the process of designing this software to maximize adoption by users. More specifically, I will focus on overcoming challenges imposed by developing software for user groups with a large senior citizen population and how to balance their needs with the needs of the Meals on Wheels staff. This knowledge will result in a better understanding of the factors that affect adoption of new web applications and how the software development process should be modified to accommodate multifaceted user groups.

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