Chander, A., Mirzazad Barijough, S. and Okubo, Y. (2017): Enterprise Assistant Service: Supporting Employees in the Digital Enterprise. In: Proceedings of 15th European Conference on Computer-Supported Cooperative Work - Exploratory Papers, Reports of the European Society for Socially Embedded Technologies (ISSN 2510-2591), DOI: 10.18420/ecscw2017-20

Enterprise Assistant Service: Supporting Employees in the Digital Enterprise

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Abstract. Enterprises globally are seeking out and leveraging digital technologies to improve their performance and competitiveness. As data-driven personalization becomes an increasingly ubiquitous aspect of our digital experience, we believe it is likely that the rapidly digitizing workplace will explore systems for personalizing the support their employees receive. In this paper, we present our experience designing and experimenting with a pilot service that provided personalized digital tool recommendations to enterprise users, for work-related issues. This Enterprise Assistant service, or EAS, was offered for 10 weeks and served 24 users within the same enterprise. Users emailed the EAS with their questions and received personalized suggestions and follow-ups until their issue was resolved. The service addressed a variety of issues during the experiment, with a majority of users expressing interest in continuing to use it. One key finding is that user awareness of friction points in their daily workflows is quite low, leading to significant communication overhead simply to uncover an actionable issue for the EAS. We channel our findings towards design guidelines and opportunities for systems that aim to empower employees with personalized tools in our rapidly digitizing workplaces.

Introduction

Software increasingly shapes our personal and professional lifestyles by augmenting or replacing many previously analog systems of our life with digital tools (Wall Street Journal, 2011). The financial benefits of infrastructure and business workflow digitization are compelling enterprises globally to invest in broad digitization efforts in order to improve their competitiveness. By 2020, it is expected that almost 50% of IT budgets will be tied into digital transformation

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initiatives, and that 60% of the G2000 will double their productivity by digitally transforming any processes from human-based to software-based delivery (IDC, 2015). The software industry is responding to this demand aggressively, and as a result the digital enterprise application landscape is seeing annual growth of almost 20% (Forbes, 2015).

The software tools emerging from this wave of digitization serve the enterprise, and are creating some broad systemic effects regarding the anticipated role of human employees. McKinsey (2015) reports that "as many as 45% of the activities individuals are paid to perform can be automated by adapting currently demonstrated technologies". While individuals within an enterprise are increasingly becoming aware of digitization in the workplace, they discount its anticipated effect on their own jobs. The Pew Research Center (2016) reports that "even as many Americans expect that machines will take over a great deal of human employment, an even larger share (80%) expect that their own jobs or professions will remain largely unchanged and exist in their current forms 50 years from now." Lastly, a generational comfort-with-digital-tools divide is upon us in the workplace. Tech-savvy and experience-oriented Millennials became the majority in US workplaces in 2015, bringing with them new skills and values, and sharpening the contrast with Gen X workers (Elance-oDesk and Millennial Branding, 2014). Enterprises are therefore faced with the challenge of bridging the gap between the pace of technological change, and the skills and (varied) aptitude for technology amongst their workers amidst the pre-emptive directive of financial competitiveness and robustness.

Personalized data-driven services (e.g., social networks) are becoming a common aspect of our experience of the digital world. As software increasingly permeates and defines the enterprise, we expect that enterprises will experiment with various personalized support services for their employees as they navigate a rapidly digitizing enterprise infrastructure.

In a digitizing world, a basic question that an individual and an enterprise face is regarding the digital tool selection problem. Looking for a new tool or app is usually done by searching keywords in websites such as Google, Quora, ProductHunt, blogs, etc. However, searching using keywords can be inadequate because an individual may have to search many keywords until he/she finds the ones that provide the desired results. Moreover, accessibility to and visibility of these websites are not sufficient for some generations of enterprise employees.

On the other hand, there is no personalized search engine that looks for apps and software with the specification that the user wants. Since many of the apps designed for enterprises have multiple features, an individual may need to go through many of these features before finding the app that best fits his/her needs. This can be very time-consuming and frustrating. Even though one may use online stores for apps (such as the App Store and Google Play) or online software catalogues (such as Cnet.com, FileHippo.com, etc.) for this purpose, the obtained search results are based on textual searches whereas in EAS the focus is on functional search.

Our Service

To overcome the aforementioned issues with searching for new tools, we designed the Enterprise Assistant Service (EAS), which combines human attention and machine support. We call the human part of EAS "Enterprise Assistant" (EA).

During the 10-week period, 24 users engaged with the service, with an average of 4 users engaging with the service each week. On average, the EAS received 5 requests per week, a majority of which were successfully addressed. Two human EAs powered the EAS during the study, spending around 50 minutes on average on all activities related to a request from receipt to satisfactory resolution. 60% of users in our post-study survey expressed the desire to use the service again.

Our design and study experience yielded several insights that would benefit the designers of systems that generally aim to empower individuals with personalized tools in the rapidly digitizing workplace. First, there is a genuine need for personalized digital tool selection. When an individual found a digital tool (for instance, a piece of software) that did exactly what they needed it to do, they would immediately experiment with it within their workflow, and often come back to use the EAS again. At the same time, we observed a very broad lack of awareness of one's own workflow friction points in the workplace. This lack of awareness is sometimes attributable to the lack of personal or enterprise incentives for change, sometimes to workplace subcultures, and sometimes to behavioral inertia. Regardless of its cause, it leads to a lack of awareness of one's own needs, making it hard for an individual to know *what to ask for help with*. This gives us a significant opportunity to bring automation to address the problem of *identifying personal workflow friction points*. And while it seems to be hard for us to be aware of our own *internal* workflows and behaviors that could benefit from change, we seem to be excellent at pinpointing issues in workplace systems that are *external*. Several users utilized the EAS as an opportunity to vent and complain about an enterprise system or policy that was a workflow friction point for them, pointing to opportunities to utilize the EAS to estimate the institutional costs of certain policies and provide a quantifiable input towards operational changes.

Related Work

Personalization is an increasingly standard consideration in the design of services, and we subscribe to and are influenced by that zeitgeist. Our pilot service also stems from the inquiry of offering personalization in terms of supporting the usage of digital tools of employees in an enterprise (Yarosh et al., 2013; Churchill and Das Sarma, 2014; Liao et al., 2016). It is reported that knowledge workers are spending 50% of their time on the internet searching for the right information (Logical Design Solutions, 2014). Solutions to provide employees with more personalized and targeted search experiences are becoming critical for digital

enterprises (Logical Design Solutions, 2014).

The goal of EAS is to provide unconstrained search to enterprise employees, which can be framed as an "advice line." Therefore, EAS is different from services such as call centers which provide users with help only for a particular product. Given this difference and our goal of identifying potential problems with such services, which require a high level of personalization, a pilot study would fit better to our needs compared to approaches such as simulation (Mehrotra and Fama, 2003). Moreover, with the degree of complexity of the received requests and our requirements for a personalized service, technologies such as text and audio mining (Mishne et al., 2005; Kobayashi and Tsuda, 2016) could not be directly utilized for EAS as most of the processes were done manually.

It has been a decade since the panel of HCI researchers introduced the community to the then emerging area of "service innovation and design" at various institutions, positioning it as a valuable and rapidly expanding source of applied research and impact (Bloomberg and Evenson, 2006). Since then, more studies have been conducted, offering ideas on what constitute successful service in industries and how to provide it to employees. Among many of these studies, our studies are especially motivated by the idea of "technology as an enabler" (Jacob, 2016), and whether a service that offers suggestions for the usage of digital tool could function as a "hygiene factor or motivator" (Herzberg, 1966; Herzberg, 2003) for employees. Both may eventually improve efficiency at work, but the two suggest different approaches for designing an effective service (Herzberg, 1966; Herzberg, 2003; Ma and Qi, 2005; Briggs and Thomas, 2015; Jacob, 2016). In our study, we found that technology was more a hygiene factor that removed friction points at work, rather than a motivator.

Research in work practice studies has examined the experiences of employees using technologies – in other words, how employees are actually using technologies at work. Taking a holistic perspective in understanding work, their studies have informed the development of technologies, ways of working, and discovered the notion of "workspaces" (Szymanski and Whalen, 2011), which captures the social nature of technology at work. This perspective renders technologies merely devices that constitute the interrelated workplace of people, communal practices, and environments. Based on their understanding of work and technology, technologies or digital services adopted at work need to be examined in contexts, or in an enterprise as an organizational whole (Szymanski and Whalen, 2011; Suchman, 1995). Using ethnography and other approaches, researchers have studied humans in the system such as in call centers to examine the mechanism of the system. They have investigated call center staff and understood its operation as a consultative work (Muller et al., 1995). In addition, the complexity, dynamics, and stressfulness of knowledge work of these agents has been revealed and documented (Szymanski et al., 2002). A close examination of the complex workflow of EAs as the humans-in-the-loop was beyond the scope of this study; however, we acknowledge its need for the service design and improvement as the size of EAS increases in the future. In the spirit of work practice studies, we devoted a significant amount of time to understanding the

contexts in which our users did or did not use EAS and how it did or did not integrate into their existing way of working, and report on these findings in later sections.

Service Design

Procedure

For the initial bootstrapping of the service, we sent out a survey to group of 26 employees of the enterprise. The survey included some questions regarding demographic information and digital tools that users use regularly. Moreover, we asked some questions about the issues they might face in their workflow, such as: "We use digital tools (software and hardware) every day to get our work done. Could you name one instance where the interaction with such digital tools is frustrating for you, in terms of getting your work done?"

After that phase, users were recruited in multiple phases using different promotion strategies in different departments. This was to raise the awareness of our service in our enterprise (within our company and outside our company), and to develop and build a strong user base for our project. Using various promotion methods – email, social networking services, in-person, etc., we approached 114 people in total. We emailed 87 people, reached out to 46 of them in person, and casually approached 27 people in person while placing promotion materials in the buildings. Throughout our study, the number of our users grew to 24, which shows a success rate of 21%.

Two undergraduate students, who were "digital natives" with a technology background, were hired as EAs for the service. They collected experimental data and analyzed the data for the development of the EAS. The EAs were anonymous to the users of the service.

Service Flow

When a user faced an issue in their workflow and wanted to select a tool to overcome the issue, they would communicate the issue through email to EAS. Each issue that a user sends is called a request. After receiving the request, one or more of the EAs would ask for a deadline, and then work on the issue, suggesting a tool to the user to resolve the issue or asking some questions in order to first clarify the issue. If the suggestion was what the user was looking for, EAs would assume that request to be closed. Otherwise, EAs would continue communicating with the users in order to resolve the issue to the fullest possible extent. In this process, EAs focused on three questions: "What tools to use?", "How to use the tool?" and "How to personalize the tool?" EAs used search engines, EAS databases on previously asked requests/solutions, tools, and user related information (such as the OS they use) in order to select a tool.

EAs collected demographic data and information about the user's phones, PC

machines, etc. Moreover, they tried to collect as much information on users and user issues as possible through their communication with users. For instance, if a user reported an issue regarding their Outlook, and EAs asked for its version, the information was recorded for potential future requests.

The workflow of EAs was closely observed in order to determine how to optimize the EAS process. EAs met with the EAS team every day for an hour to discuss any issues they encountered in solving the requests, but the meetings became infrequent toward the end of the study as EAs became more accustomed to their work. For more efficient and quality searches, peer support was suggested.

Research Design

During the 10-week pilot study, the EAS team contacted 46 users for in-person follow up of the people whom we invited by emails. The length of each meeting varied from 10 minutes to one hour. At the meetings, the EAS team collected feedback from users and employees regarding promotion methods and issues they encountered while using our service. We also conducted a survey to get user feedback two weeks after the pilot study had concluded.

Participants/Users

24 employees (10 females and 14 males) were recruited as volunteer (non-paid) users from our company. Participants ranged in age from their 20s to 50s, with more than half in their 40s and 50s. This turned out to be a limitation of this study. They were all "knowledge workers," and their job functions varied from administration, business, research, to management.

To distinguish our service from the organizational IT support and conducting the internet search, the goal of the EAS was to offer personalized solutions to each user. Thus, the understanding of each user issue while clarifying and acknowledging their requests was the key. For that purpose, the EAS team provided EAs with documents presenting Email Guidelines and Email Templates for communicating with user at each phase of the EAS. Utilizing the strength of human EAs, we made our service as humanlike as possible so that users could feel that they were actively being listened to and engaged by EAs.

Data Analysis

We analyzed four data sets for our study; 1) data on users and requests collected by EAs and entered into databases; 2) emails between EAs and users; 3) notes from in-person follow-up meetings and promotion with users and employees; and 4) user responses and feedback in the initial bootstrapping survey and post-service survey. The numbers of users and requests were counted weekly and organized as a data set for each analysis. All the data sets were cross-referenced

during this study. As such, we combined qualitative and quantitative analysis in this study.

Analysis and Findings

Request Analysis

Throughout the study, the EAS received 48 requests. These requests fell into different categories and some of them were not really of the nature that was expected for this service. EAs were not able to provide any suggestion for these particular requests. In order to understand requests more appropriate for the EAS, we categorized requests based on 1) type, 2) status, and 3) nature as follows:

(1) Type:

- IT: requests about issues that can be solved only by the IT department such as "WiFi is not working".
- Enterprise Infrastructure: the requests which are about the issues concerning the websites or services provided to employees by the enterprise, which the authors are affiliated. "Expense report website is not working" is an example of a request in this category.
- Q & A: requests which cover issues with the tools that they are currently using and asked for solutions to improve their interactions with these tools. Two of the requests that we received in this category were "how to add hyperlink to a part of a text in an excel cell" and "how to export part of an email to an Excel sheet in Outlook".
- Non-work related: requests which, for EAS, were not directly related to issues that one may have with their workflow. "Is there a text expander for iPhone" is a question in this category.
- Enterprise: requests specifically asked for new apps, service, etc. in order to address an issue in the workflow and possibly increase efficiency. "Looking for a collaboration software" and "looking for a free knowledge base tool" were two requests in this category that EAS received. For each of these requests, users specified some requirements.
- Development: requests related to issues one may have in development tasks, such as "How to resolve undocumented bugs while using a software."

(2) Status:

- Success: a request is called Success if the requester informed the EAS that they were happy with the suggested solution.
- On Going: a request is On Going if the EAS is still working on it.
- Out of Scope: a request is Out of Scope if it is beyond the scope of the EAS, meaning that EAs were not able to provide a solution by doing a publicly available search. In general, we considered IT, Enterprise Infrastructure and Development requests to be Out of Scope because they required EAs

to have some special privileges from the associated departments or software/coding skills to address those requests. Moreover, these requests could be handled by the associated department itself. “WiFi is not working” and “expense report website is not working” are two examples of the questions in this category.

- Time Out: a request is called Time Out if the requester stopped communicating with the EAS before the issue is resolved.

(3) Nature:

- Requests asking for the information: requests which want to obtain the information about the tool of inquiry, or about how requesters can improve their interactions with the tools. “How can we amp up a presentation?” and “is there a free or inexpensive tool to combine video and audio files in QuickTime?” are examples of requests in this category.
- Requests trying to overcome hindering factors: requests which want to find ways to overcome frictions between the tool of inquiry and their workflow, such as “My mouse is not working. It is too slow, and replacement batteries did not work” and “how can I get Wifi working?”
- Requests trying to find ways to become more productive: requests which ask for ways to make workflow more efficient and productive than what is foreseen with current solutions (apps, software, service, etc.). Examples of requests here are “what is the most convenient way to get files from Mac to my PC?” and “is it possible to keep track of signatures required for a document?”

The “type” categorization helped us understand the issues that users were dealing with. The “status” categorization provided a measurement of the EAS success, and finally, the “nature” categorization reflected a pain point that users tried to resolve with their request. Table I shows the breakdown in each category.

Table I. Breakdown of requests

IT	Ent. Infra.	Q&A	Non-work	Ent.	Dev.
6	7	9	3	20	3
Success	On Going	Out of Scope		Time Out	
15	7	13		13	
Want info.		Hindering		Productivity	
18		12		18	

As for the Out of Scope requests, EAs didn’t immediately decline them so that we could examine the boundaries of the EAS. Among the 13 Out of Scope requests, EAs provided indirect but personalized suggestions to 11 of them.

In order to understand how each of the previously explained categorizations is represented in Success requests and Out of Scope requests, we performed the

following analysis

According to Table I, 15 requests, or 31% out of the total 48 requests were Success, while 13 requests, 27%, were Out of Scope.

60% of 15 Success requests fell under Enterprise, which was higher than 42% of the total 48 requests in Type categorization. 53.3% of Success requests asked for information, which was also slightly higher than 53.3% of the total requests in Nature categorization. On the other hand, 6.7% of Success requests wanted to remove hindering factors, which was lower than 25% of the total requests in Nature categorization.

54% of 13 Out of Scope requests were regarding Enterprise Infrastructure, which was higher than 15% of the total requests in Type categorization. 84.6% of Out of Scope requests were for removing hindering factors, which was higher than 25% of the total requests in Nature categorization.

Thus, requests that categorized as Enterprise and that asked for the information resulted in higher success rate, while requests that addressed the issues of Enterprise Infrastructure and that wanted to remove hindering factors more likely ended up in Out of Scope.

User Engagement Analysis

We had 24 users and 48 requests during our 10-week pilot study. In this section, we provide a closer look at users by examining 1) user growth and engagement based on user and request counts for 10 weeks and 2) user experience with the EAS, in particular, how many of the users had a successful experience in receiving their personalized solutions.

(1) Active users:

We classified users into two groups as it is shown in Figure 1. New users are those who sent their requests to the EAs and interacted with them for the first time. Existing users are those who had previously interacted with EAs and returned to our service. The largest number of users was 9, including 6 new users and 3 existing users in Week 8, following massive promotion strategies in the previous week. However, EAS was not able to acquire any new users in weeks 9 and 10.

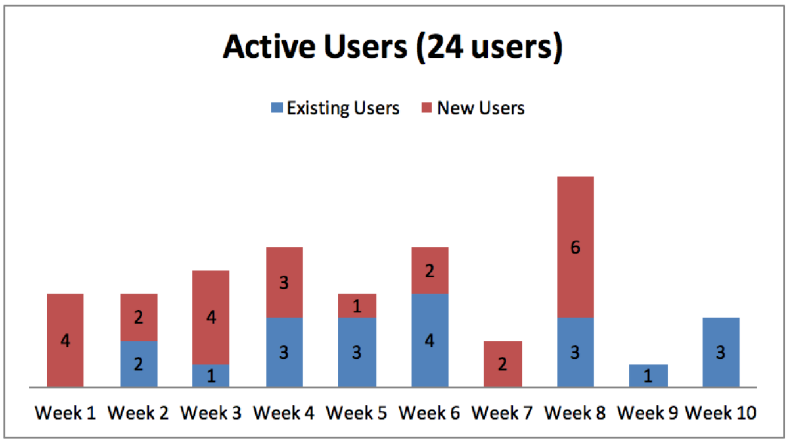

Figure 1. Active users.

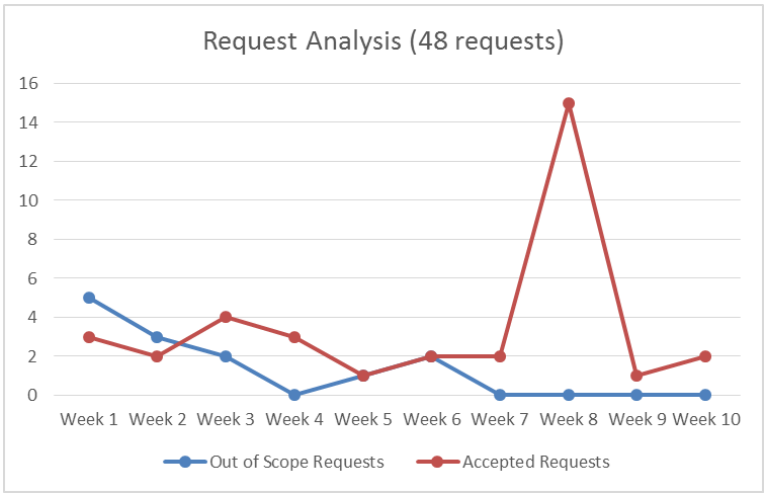

Figure 2. Request analysis.

Figure 2 presents the breakdown of 48 requests into Accepted and Out of Scope requests. We defined Accepted requests as the requests that were not determined as Out of Scope and that were processed with EAS for suggesting personalized solutions. This includes the requests that were eventually categorized as Success, On Going, and Time Out in EAS offering as shown in Table I and Figure 3. It illustrates that the number of Out of Scope requests decreased toward the end of our service. As seen in Figure 2, there were 13 requests which were considered Out of Scope in 10 weeks. Many of them were concentrated in the first three weeks. Also, our collected data demonstrates that all Out of Scope requests were made by new users each week. On the other hand, we found out that users who continued to use our service submitted requests which were not Out of Scope, even though they sent an Out of Scope request as their first request, as seen in users 1, 2, and 19 in Figure 3. We believe that these users realized the scope of the service and returned to our service with appropriate requests, which contributed to the decline of the Out of Scope requests.

(2) User success with the EAS:
Based on request results, 24 users were categorized into 4 groups according to their experiences with the EAS: 1) users who only had Out of Scope requests, 2) users who experienced at least one success with our service, 3) users whose interactions with the EAS were ongoing, and 4) users whose requests timed out. A success was recorded when users responded to the EAs with appreciation after the EAS sent them our solutions. Users with ongoing interactions mean that the EAS has not completed their requests and still in touch with users. Users whose requests timed out are those whose interactions faded out due to an extended response time (usually after 3 business days). Our analysis shows that 38% of users (9 users) had at least one success in submitting their requests, 33% (8 users) submitted only Out of Scope request(s), followed by 25% (6 users) whose requests had timed out.

A closer look at users and their requests in Figure 3 demonstrates that users with Out of Scope requests were more likely to not continue using the service, contrasting with those users whose requests fell under other categories. In addition, when the requests timed out (such as for users 14, 15, 16, 18, and 21), those users also did not return to our service. These two observations suggest that reducing the number of Out of Scope requests and Time Out requests is a key for the continuing growth of our service.

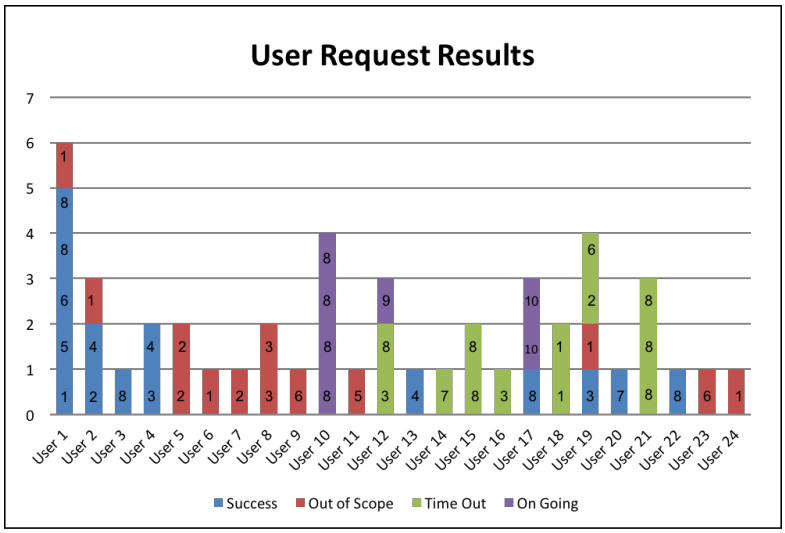

Figure 3. User request results. User numbers are given randomly in this figure. The numbers in bars show the week numbers that users submitted each request to EAS.

Service Feature Analysis

In this section, we examine user frictions and expectations for the EAS by analyzing the result of user survey responses and feedback conducted two weeks later.

We conducted a survey to get user feedback two weeks after the pilot study was completed. Surveys were distributed to 23 users in person and to 1 by email. They were collected from 20 out of 23 users, 40% female and 60% male.

Regarding the user experience of the EAS, we asked several questions on suggestions and service. Results indicate that about 45% the respondents (n = 9) were either very satisfied (n = 5) or somewhat satisfied (n = 4) with the suggestions that the EAS offered. Including those who had neutral responses to our suggestions, a majority of the respondents (n = 17) were satisfied or neutral with the suggestions that the EA service gave them. Computing the Mode value for the Likert item regarding suggestion, we deduce that neutral option has been chosen more often by the users.

As for the EAS as a service, the value of Mode represents that users chose very satisfied and neutral with the same frequency. More than half of the users were either very satisfied (n = 6) or somewhat satisfied (n = 5) with the EAS as a service.

The dissatisfaction for our service and suggestions were the same (n = 2 and n = 1 people for somewhat unsatisfied and unsatisfied with the suggestions, respectively). Those who were dissatisfied with our suggestions were also dissatisfied with our service. Based on the results for another question in the survey, among the 20 respondents, 60% of them have tried out the solutions.

Since the goal of our service was to improve workplace productivity by offering personalized solutions using digital tools, we asked whether the users were able to save or gain any relevant resources, such as time, money, mind-space (attention), or information. The results show that respondents gained more new information from using our service (n = 10), followed by time (n = 8), mind-space (n = 6), and lastly, money (n = 3). Please note that not all users responded to this question, and some users chose more than one answer.

Based on the results for the last question in the survey, a majority of respondents stated that they are very likely (n = 7) or somewhat likely (n = 5) to use our service again. The value of the Mode states that many of the respondents are very likely to use the service again. Moreover, 5 people chose neutral for this question, and 2 and 1 people chose somewhat unlikely and unlikely for this question, respectively.

Correlation between Likert items:

To further analyze the results of the survey, we computed Spearman's correlation coefficient to find the following correlations: 1) correlation between user satisfaction with the service and the likelihood of using the service again, and 2) correlation between user satisfaction with suggestions and the likelihood of using the service again. The correlation coefficients are 0.96 and 0.95, respectively. These values show a strong correlation which is predictable.

Moreover, we wanted to know if there is any difference between two groups, (who tried out the solution and who didn't) in their responses to three Likert items (satisfaction with service, satisfaction with suggestion, likelihood of using the

service again). We used two-sided Mann-Whitney test with $\langle = 0.05$, which we determined to be an appropriate test given the small size of data set. The obtained p-values are 0.46, 0.3, 0.3, respectively. This shows that there is no statistically significant difference for these items between the two groups.

Correlation between Likert items and requests:

As explained before, all the requests are categorized into four groups based on the status: Out of Scope, Time Out, Success, and On Going. In order to see if there is any difference between these groups in terms of the responses to three Likert items (satisfaction with service, satisfaction with suggestion, likelihood of using the service again), we used Kruskal-Wallis test with $\langle = 0.05$. However, we didn't observe any statistically significant difference between these groups of requests for any of the Likert items ($p > 0.05$).

We repeated the same procedure detailed above for the categorization based on nature: if they were addressing hindering, productivity or looking for information. Similarly, we didn't observe any significant difference between the three groups of these requests for any of the Likert items ($p > 0.05$). However, the values of Mode suggest that users responded neutral more frequently to all three Likert items when the request was categorized as hindering, but very satisfied and very likely to try out when the request was categorized as looking for information or productivity.

Correlation between Likert items and user profiles:

Finally, to see if there is any difference based on gender to three Likert item responses, we used a Mann-Whitney test with $\langle = 0.05$. Again, the computed p-value ($p > 0.05$) suggested that there is no statistically significant difference between genders for the responses.

Reflections and Guidelines

Here, we take a step back to reflect more broadly on our experience and findings by analyzing the notes from the in-person follow up, the result of user survey responses and feedback presented in the previous section. We also offer guidelines to designers of personalized digital tool support systems.

- *The Quick-Query Expectation*

In a world where information searches are done with entering query terms in a search engine, where messaging platforms (e.g., Slack, Facebook Messenger) have removed the need to provide "subject lines" for short communication, and the rise of voice-driven assistants like Apple's Siri and Amazon's Alexa, users experienced email as a costly query interface for a perceived information service. User feedback revealed that users felt the need to structure their query like a

proper email, which not only took them further from the modern keyword-based query mindset but inhibited them from actually sending some queries due to the anticipated wait time for an explanation. Given the "always-on" nature of web service, our query behavior has evolved into an iterative one where we may start from a vague query and use the instantaneous and sometimes erroneous results to shape the query itself. Email as the only available channel to interact with the EAS required more cogent queries, which reduced how frequently users queried the EAS.

● *The Always-On Expectation*

A related expectation was for the EAS to be always-on and to respond immediately. With humans involved in the loop of the EAS, this was not the experience we offered during the study. A variety of automated response mechanisms can mitigate the sense of "query lost in the void" that comes from latency in digital services, even though it cannot be completely eliminated in the current design of the EAS where the human has a crucial part to play.

● *The Fix-our-Shared-Problems Expectation*

Enterprise problems that are regularly experienced and shared by several users in an enterprise, such as infrastructure (e.g., WiFi) and policy (e.g., travel booking and reimbursement) issues, were more easily mentally accessible for our users as reportable issues for the EAS. 15% of the requests in our study (Table I) were about the enterprise infrastructure. Fixing enterprise and policy issues was Out of Scope of the EAS, but requests of that nature were the vast majority (10 out of 13) amongst those eventually marked as Out of Scope. The ability to easily recognize and point out hindering factors regarding the expected environment in their workplace points to a system design where the EAS matches quantitative data revealed by group participants to policy stakeholders in an enterprise. We see addressing these issues as "hygiene" factors in terms of the discussion pioneered by Herzberg (1966), and continued by Briggs and Thomas (2015) and Tuck and Hornbaek (2015).

● *The Lack of Awareness of Self-Need*

In contrast to the obviousness of the impact of shared problems on an individual's experience, we found that most users had a very low awareness of the friction points in their own workflows. Although they would recognize friction points that the EAS could help them with during in-person conversations, and they would find a match between our sample problem digests and their own needs, it was clear that individuals had in general adapted to workflow issues that may initially or previously have been considered a friction point. As opposed to shared problems, whose awareness was likely higher on account of social sharing and venting about those problems, individual problems did not benefit from the same mindshare. This lack of self-need is in particular a significant challenge towards scaling a service like the EAS. There is a significant opportunity to provide behavioral analytics that automate or assist with the process of uncovering individual needs in the enterprise.

● *The Inertial Mindset*

Based on the user feedback, we could observe that in a large enterprise, such as

the one where the study was conducted, employees deal with tasks within some set conditions, and they don't necessarily look for new ways to do their tasks. If they face any issue, they usually have a workaround which is not necessarily efficient. This observation is consistent with a study result which states that less than one-third of U.S. employees were engaged in 2014, with 17.5% "actively disengaged" and 51.4% "not engaged" (Gallup, 2015). We believe that significant efforts toward cultural change and support is necessary to enable at-scale adoption of digital tools by employees to improve their efficiency.

- *The Financial Floor*

A human Enterprise Assistant spent 50 minutes on average addressing each request. Therefore, each request cost almost $17 for our pilot study. Even though this cost is comparable with other assistant services, it is not clear if an enterprise would invest in such a service at these prices for their broad employee base, or for just a selection of them. Certainly, there are various opportunities to automate various aspects of the EAS and to bring its human cost down; moreover, the greater the number of users, the lower the cost per user because of higher rate of repeat questions, and the value afforded by connecting individuals with questions to individual with answers.

- *The Human Factor Expectation*

The presence of human beings as part of the service is quickly revealed to end-users because of the sophistication of responses to their initial email query. This awareness of a human-in-the-loop has an interesting side-effect on the EAS end-user: they start expecting a higher level of customer service, such as one might get from a customer service call center. Our intention in including humans as part of the EAS was to address the limitations of search options to solve the digital tool selection problem, valuing them for their ability to curate personalized solutions. As humans, they are perceived to have other values by our end-users as well, such as the ability to provide a higher level of service beyond personalized solutions to the digital tool selection problem. This may take the form of wanting the human EAs to be dispatched to their workplaces to assist them in person, perhaps influenced by expectations of the support offered by typical enterprise IT departments. This poses an interesting challenge for EAS-like systems to design for communicating the availability of its human and the machine components clearly.

When these expectations were not met, users experienced a friction between their expectation of the EAS and its actual abilities, resulting in Out of Scope or some Time Out requests. Two-thirds of users who experienced the two were unlikely to return to our service. We offer these reflections and suggest vectors of resolution above to designers of future systems for solving the personalized digital tool selection problem in the enterprise.

Conclusions and Future Work

As enterprises definitively digitize an increasing amount of their functions and

operations, they face challenges in supporting their human resources with navigating the changing, increasingly digitally assisted nature of their work. We expect enterprises to explore personalized solutions for support services in the rapidly digitizing workplace, given the abundance of and access to digital tools (e.g., software) today. However, the long tail of applications, the multiplicity of features supported in individual applications, and the lack of efficient search engines for matching applications with user needs makes us look towards human-machine hybrid services to solve the digital tool selection problem: What digital tool can I use to address my need? In this paper, we reported on the design of such a hybrid service, described a 10-week study carried out with 24 users in an enterprise who used the service, and analyzed and reflected on a wide variety of findings. We note that the need for personalized digital tools is real, but the awareness of the possibility of improvements in one's workflow is low. Macro forces related to the march of technology are forcing the awareness for improved utilization of human resources on enterprises, and here we offer our findings on the behavior around, and expectations for such services to designers of future systems.

A variety of future work opportunities to improve the automated support available in the Enterprise Assistant Service are described in the paper. These focuses both on helping the human Enterprise Assistants with matching incoming queries with internal curated databases and their overall workflow, as well as serving end-users better with automated communication tools. Our own experience points us in the direction of exploring automated or assisted behavior analytics, where we address the problem of identifying needs of employees in an enterprise by analyzing the gap between expectations placed on them and their current behavior using a mixture of qualitative and quantitative tools.

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