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Longitude: A Timeline Visualization of Organizational Processes

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ABSTRACT

Organizational processes taking place over long periods of time require intermittent coordinated collective activity. We are exploring graphical timeline representations as a shared visual context for participants to plan, remember, and track process commitments. Semi-structured interviews and iterative prototype development were used to create a timeline software visualization that aggregates and filters feeds of process-specific information, including descriptions of shared tasks, resources, and deadlines.

Author Keywords

Timeline, visualization, organization, process.

ACM Classification Keywords

H5.3. Information interfaces and presentation (e.g., HCI): Group and Organization Interfaces.

INTRODUCTION

This work focuses on designing systems that support organizational processes. In the broadest sense, an organizational process is anything taking place over time that is performed by an administrative or functional entity, such as a business, school, or other institution. Organizational processes operate over long periods of time (e.g., months or years), require the collective action of many people, and necessitate intermittent attention to a time-constrained sequence of tasks. Participants may be engaged in several processes simultaneously.

While the work involved in supporting organizational processes typically falls on human administrators and managers, the entry, transport and aggregation of their data

has become the province of digital systems. In addition, digital systems have begun to take on the role of reminding those engaged in the process by sending announcements, prompts, and you-are-late notices, often through email.

However, email was not originally designed with this sort of use in mind, and, as has often been observed, the increasing quantity of email has caused difficulties for end users (e.g., [19]). One approach to this problem, exemplified by Bellotti, et al. [2], is to better support the management of tasks within email. While this approach seems promising in some circumstances, note that Bellotti et al.'s claim that "dealing with email and managing tasks and projects are indistinguishable," does not hold for organizational processes. Organizational processes are largely distinct in content and temporal scale from the tasks and projects of daily work, and, as we shall see, are often not considered part of work at all.

In this paper we report on the first stages in the design of a system for better supporting organizational processes. Specifically, we will argue that a single shared chronological view of the tasks involved in a process should enable participants to coordinate dates and commitments, sequence their work, anticipate deadlines, and plan ahead.

There are three contributions of this paper. First, through interviews with participants and administrators, we provide a view of the task management, communication and coordination issues associated with long-running organizational processes. Second, through iterative design, we identify elements of visualizations to support people engaged in organizational processes. Third, through implementation of a prototype using real organizational processes, we show how a compact and customizable timeline visualization widget can provide the visual context needed.

RELATED WORK

Timelines are a common graphical design for displaying information [18]. They are used routinely in finance, education, project management [9] and other fields to depict both static and dynamic time-referenced data [15].

Timelines have also been used to visualize social interactions [5, 6, 7], emergent work activity patterns [14], personal histories [17], digital document metadata [12], and operating system files [8]. However, there has been relatively little work on interactive visualization of processes that span large organizations. Bellamy et al. [1] report on the use of visualization for organization-wide risk and compliance monitoring, but this work focused primarily on compliance officers as users and only supported status monitoring.

USER STUDY

We decided to focus our user study on a single organizational process. We selected the performance review process because it is implemented company-wide and was identified as a key problem area by the human resources department.

Method

We recruited six employees from our organization who were actively engaged in the performance review process. All employees were interviewed in their normal workplace setting. Interviews were semi-structured, consisting of a set of questions (see Table 1), but related issues and topics were discussed in response to many of the questions. Interviews lasted approximately one hour.

We asked about performance reviews from three perspectives: first, as a concept of annually setting goals, measuring results, and rating success; second, as an organizational process integrated into the work practices of employees; and third, as the task of documenting goals and results using the company’s web-based tool.

1. How many years have you been at the company?
2. Do you also manage reports?
3. What are your biggest complaints as an individual about the performance review process?
4. How much time do you spend creating your performance goals?
5. How important do you think it is for you to think about your performance review throughout the year? How often?
6. What kind of reminders would be helpful throughout the year? Advance of required actions? Reminders to keep goals in mind? Guides to best practices?

Table 1: Sample Interview Questions for User Study of the Performance Review Process

Results

Our interviews revealed a significant lack of awareness about the timetable, milestones, and status of the performance review process. Participants reported that the

process was not ‘top of mind’ every day and deadlines were often not known or recorded on a ‘todo’ list or calendar.

Furthermore, there was often uncertainty about deadlines. Participants reported that each organization manages tiers of due dates: a first line group has one due date, a second line group a second, and so on, so that the final chain of approvals will “roll up” the hierarchy in time for the corporate deadline. Similarly, because of travel or other constraints, the manager of one group may set a different due date than that of a neighboring group. One employee reported that deadlines may sometimes be negotiated with management on an individual basis.

Our interviews also showed that people had considerable difficulty scheduling time to work on the performance review process. Interviewees complained that the process did not fit into their ‘regular job’. They also explained that the process takes place concurrently with other processes, such as funding and project planning, making synchronization of project goals and deadlines difficult.

Implications

The fact that participation in organizational processes is not seen as part of one’s ‘real job’ seems symptomatic of a deeper problem. That is, workers have a variety of ways that they structure their daily work: some are formal (project reviews, staff meetings), some personal (to do’s, action items), and much is simply in response to the day-to-day activity of co-workers, but all come together to produce the flow of daily activity. Organizational processes fall outside of these activities and thus we have the reported lack of awareness, uncertainty about deadlines, and difficulty scheduling tasks. To us this suggests the need for a different and distinct approach to supporting organizational processes and their deadlines.

LONGITUDE: A TIMELINE VISUALIZATION FOR ORGANIZATIONAL PROCESSES

Following the user study, we started work on a software prototype. Our primary design goal was to provide a visual chronology of multiple processes over the span of a year. We wanted the users of the visualization to not only notice upcoming deadlines and examine task requirements, but to actively make plans and commitments. A second design goal was to allow users to create a customized view of just those processes relevant to them. A third goal, perhaps conflicting to some degree with the first two, was to provide a shared visual context for participants to communicate and better coordinate their actions. Lastly, we wanted users to have easy access the tools and resources needed to complete process tasks.

Given the need for a chronological sequence, we immediately thought of a timeline. A timeline provides an intuitive representation for time-referenced data with a natural ordering and scale that affords comparison. Further, large numbers of data points can be displayed at once with the ability to move quickly over large gaps in the sequence.

The Widget

We built the Longitude software prototype as a Web-based graphical desktop widget (see Figure 1) using a powerful visualization toolkit [3]. The default view provides a 14-month overview. The compact display affords peripheral awareness of upcoming tasks and deadlines. The icon and associated text for each task are placed horizontally in time and stacked vertically to avoid text overlap.

Users can navigate to a task by dragging the canvas horizontally or by scrolling vertically. Task titles and due dates are listed by process on a pull down menu below the timeline. Selecting a task scrolls the timeline to its due date, even if the task is out of view. Clicking on the task title produces a small window with a detailed description of the task, its exact due date, and any links to additional tools and resources that the process owner has entered.

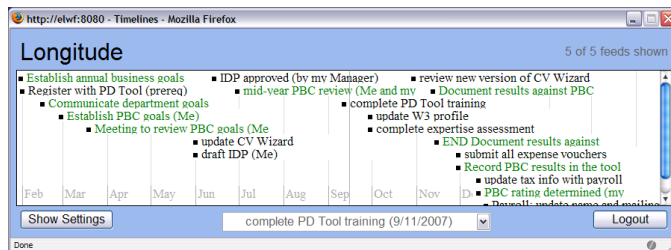


Figure 1 : A timeline visualization of five processes

Feeds, Templates, and Tags

Users create new processes using a web-based form by adding tasks, each of which has a due date, then adding supporting files and hyperlinks [11]. Users can target processes to particular organizations, geographies, or roles using special tags. The processes then become available as a data feed. Each entry in the feed has a hyperlink to the form where it can be viewed or edited.

Any user can contribute a template for a new type of process based on best practices [14]. Individuals, groups, and organizations can then develop customized versions of these processes. Once all tasks are completed or abandoned, processes can be marked as completed.

The software periodically accesses and aggregates source feeds. By default all process-related feed sources are included. However, the user can use settings in the timeline to display only personal, group, or organization-wide processes. Completed processes are excluded by default, but can be included if the user is interested in an historical view. Because feeds are in a standard format, users can also add feeds from other Web sites reflecting, for example, school schedules, holidays, or charitable events.

After the software authenticates the user, it accesses their organization, work location, and other information from the corporate directory and creates a set of *contextual tags*. It then queries the database for process feeds with any of these tags. Users can remove these tags if they do not apply. They can also provide their own tags. They can then filter the set of aggregated feeds by selecting particular feeds of

interest from a list of titles. Finally, they can assign one of ten colors to the selected feeds to distinguish, for example, different organizations, processes, or priorities.

Customization

Users of the visualization can control the display of time bands at different resolutions. Since we were focused on long-running processes, we set the default view to a year, with two additional months for context. Users can also select a two-week view for short-range planning. We also provide a dual band display with a week on top and a year on the bottom. The year overview has graphical marks for each task, affording a glanceable perceptual cue to task density. The user can scroll to important dates and simultaneously scan the week band to see relevant information for that task in the context of other task commitments.

By default, we display only dated tasks on the timeline. However, users can also configure the timeline to show icons for bookmarks, files, and comments contributed by users. Settings can be configured and then hidden, or displayed under the timeline canvas to support exploratory visualization. All settings are remembered between invocations of the widget.

Adoption

We will deploy the timeline visualization to early adopters across the company in the next month. In preparation, we are adding features to collect feedback and log usage. We are also populating the database with tasks and deadlines for several processes relevant to our world-wide research laboratories. We will then carry out observations and interviews with this population.

DISCUSSION

Initial reactions from researchers who have tried the software have been positive. Task deadlines can be determined by visual inspection instead of by multi-step interactive search [4]. Users can focus on requirements and deadlines of interest using feed filters, selections, and color annotations. The compact self-updating display makes it possible for users to monitor task status.

Users must currently go to a separate web page to create and edit processes and tasks. However, Payne's studies of calendar use (e.g., [16]) reveal that people often only review existing entries while adding new entries. It may thus be important to allow direct manipulation editing of tasks and deadlines on the timeline.

In future work, we would like to explore how to visualize changes in organizational processes. Visual indications of use, i.e., "read wear" and "edit wear," may be useful [10]. However, users may want a visual indication of what kind of change is taking place. For example, processes could change ownership, requirements, sequence, or targeted organization. We want to understand whether depicting these kinds of changes will be useful.

Malone and Crowston [13] argue that making organizational processes explicit can influence the operation of the entire organization and facilitate the development of best practices. However, our interviews indicate that people do not typically record the tasks and deadlines associated with organizational processes that are administrative and peripheral to work, such as performance reviews. People may not even think of them as holistic processes. Instead, they engage in this kind of process work intermittently at the prompting of computer systems, managers, and peers. Overloaded with email, they may miss deadlines or perform poorly due to divided attention.

To address these problems, we designed and implemented a timeline widget that provides a visual context for participants to plan, remember, and monitor tasks and due dates. Users can customize the timeline to aggregate and filter feeds with process data. Monitoring the widget could become a daily activity of people engaged in mandatory organizational processes.

CONCLUSION

The widespread use of shared visualizations of the tasks and deadlines of long-running processes could have a profound effect on organizations. People in the organization would have one aggregated view of process-related information and have immediate access to the latest process requirements, instructions, and due dates. People would be able to monitor relevant tasks and be more likely to anticipate deadlines. Users of the visualization would have a shared visual context for communication and coordination for processes they have in common. People could become more aware of their responsibilities to the organization and modify their behavior accordingly.

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REFERENCES

1. Bellamy, R.K.E. et al, "Seeing is believing: Designing visualizations for managing risk and compliance" *IBM Systems Journal*, 46, 2 (2007).
2. Bellotti, V., Ducheneaut, N., Howard, M., and Smith, I. 2003. Taking email to task: the design and evaluation of a task management centered email tool. In *Proc CHI 2003*. ACM Press (2003), 345-352.
3. Butler, M, H.; Gilbert, J., Seaborne, A., Smathers, K.. Data conversion, extraction and record linkage using XML and RDF tools in Project SIMILE. HP Labs Technical Report HPL-2004-147, 2004.
4. Card, S. K., Mackinlay, J. D., and Shneiderman, B. Readings in Information Visualization: Using Vision to Think, Morgan Kaufmann, San Francisco, CA, USA (1999).
5. DiMicco, J.M., Hollenback, K.J., and Bender, W. Using visualizations to review a group's interaction dynamics. In *Proc. CHI 2006*, ACM Press (2006).
6. Erickson, T., Huang, W., Danis, C., and Kellogg, W.A. A social proxy for distributed tasks: Design and evaluation of a prototype. *Proc. CHI 2004*, ACM Press (2004), 559-566.
7. Erickson, T. & Laff, M. The Design of the 'Babble' Timeline: A Social Proxy for Visualizing Group Activity over Time. *Proc. CHI 2001*. ACM Press (2001).
8. Freeman, E. and Gelernter, D. Lifestreams: A Storage Model for Personal Data. *SIGMOD Record*, 25, 1 (1996).
9. Gantt H. L. *Work, wages, and profits*, Hive Publishing Company, Easton, Pennsylvania, USA, 1974 (republished from 1910 original)
10. Hill, W. C., Hollan, J., Wroblewski, D., and McCandless, T. Edit wear and read wear. *Proc. CHI 1992*, ACM Press (1992): 3-9.
11. IBM Lotus Connections Product <http://www306.ibm.com/software/lotus/products/connections>.
12. Kumar, V., Furuta, R., Allen, R.B. Metadata visualization for digital libraries: interactive timeline editing and review, *Proc. of the Third ACM conference on Digital libraries*, ACM Press (1998), 126-133.
13. Malone, Thomas W. and Crowston, Kevin. Tools for inventing organizations: Toward a handbook of organizational processes. *Management Science* 45, 3 (1999), 425-443.
14. Moody, P., Gruen, D., Muller, M.J., Tang, J., and Moran, T.P. Business activity patterns: a new model for collaborative business applications. *IBM Systems Journal*, 45,4 (2006), 683-694.
15. Ocha, G. "The Timeline Book of Arts", Ballantine Books, New York, USA, 1995.
16. Payne, S.J. Understanding Calendar Use. *Human Computer Interaction* 8,2 (1993), 83- 100.
17. Plaisant, C., Milash, B., Rose, A., Widoff, S., and Shneiderman, Ben, LifeLines: Visualizing Personal Histories. *Proc. of ACM CHI 1996*, ACM Press, 221-227.
18. Tufte, E.R., *The Visual Display of Quantitative Information*. Graphics Press, Cheshire, Connecticut, USA, 1983.
19. Whittaker, S. and Sidner, C. Email overload: exploring personal information management of email. In *Prox. CHI 1996*. ACM Press (1996), 276-283.