Connecting the Social and Technical Aspects of Computing with Visualization

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1. Introduction

In software development projects, dependencies between developers arise from dependencies in the source-code they write. This observation emerged in our own field studies [3] and the related literature. In response, we created Ariadne, a visualization tool that allows end-users to explore socio-technical relationships in software development projects.

The primary inspiration for this work is the field of software and information visualization [1, 6]. In the domain of software development, one seminal example of visualization is SeeSoft [4]. SeeSoft demonstrated that the source-code for a whole software system could be shown on a single display, as well as statistics for each line of code, to support the analysis of and improvements to the development process. In general, visualization remains a powerful way to integrate information from different sources into a set of visual representations, reducing the visual complexity and mental effort required of the user to interpret them.

Another field that has had a large influence on the direction of Ariadne is Social Network Analysis. Certain metrics such as centrality [8] can indicate who is important or influential in the network based on a variety of factors. Other metrics can identify clusters of people who share similar roles or interact with the same people. The results from metrics can be used to establish structure in and meaning to the data.

Combined, visualization and social network metrics have potential to reveal socio-technical relationships in the software development process. However, it is not so clear what metrics are meaningful and useful, and perhaps more importantly, how managers and developers should react once they are presented with socio-technical patterns in their organizations. Ariadne represents a starting point toward answering these types of questions. This research abstract describes the current status of Ariadne, some initial evaluation results, and the current research plan. Finally, Ariadne is discussed in the context of the large computational divide.

2. Implementation Status

Elsewhere in this volume we have illustrated Ariadne's visual interface and its use [7]. Essentially, the user – starting from a high-level overview – can perform a set of filtering operations to reveal socio-technical patterns of interest identified in our previous work [3].

At present, we are interested in the organizational issues related to the design and deployment of visualizations that aim to reveal socio-technical relationships. We think visualizations like Ariadne can help managers and developers see socio-technical patterns and be useful in organizations, but this is an untested empirical question. Some researchers have tried to characterize what constitutes "good" patterns of communication [2], but it is not clear what actions viewers of the interface should take, and whether organizations will be better off once these patterns are known. Ideally, understanding and acting on these patterns should improve one aspect of an organization's development process.

3. Evaluation Results

Before revising the first prototype of Ariadne, we performed an informal evaluation using an open-source project on Sourceforge.net. One developer commented that the visualization could help certain developers "shy away" from changing certain core classes used throughout the system. On the other hand, it could tempt developers to "commit on stuff they shouldn't commit on" in order to appear more influential to the project's success than they really were. These comments are indicative of the challenges of revealing socio-technical relationships via visualization in an organizational setting.

We evaluated the second revision of Ariadne with commonly used usability inspection methods. The findings from these analyses are reported on in this same volume [7].

4. Research Plan

First, this research will focus on improving Ariadne's visual interface as per the results of the recent evaluation we conducted [7]. Second, we aim to identify relevant social network analysis metrics and adapt them to the context of software development. In parallel, we will perform a literature review of the role of dependencies in organizations to identify practical tasks that could benefit from an understanding of socio-technical relationships. Moreover, we will perform a review of the capabilities and features of state-of-the-art information visualizations as well as visualization-specific evaluation techniques.

Once we have collected a significant corpus of development data to visualize, we intend to run Ariadne on the data and apply the metrics we found to be relevant. With the results we have analyzed, we will our industry partners and show them the results of our analysis, hopefully with meaningful insights that have actionable implications. Next, we will plan to run human trials experiments with developers.

5. Discussion and Conclusions

Our work has studied software developers with traditional backgrounds in distributed settings. In the future, projects will involve even more diverse sets of individuals, especially if the goal is to eventually include end-users in the development process. However, there exists a computational, and necessarily economic, divide. End-users come from different disciplines and socio-economic backgrounds. As such, they have unequal access to social and technical resources.

In a sense, Ariadne represents an early starting point for addressing one part of this large problem. One of the common ways people learn about tools is by traversing their own communication networks to find individuals who have the knowledge. This was one conclusion of Gantt and Nardi's earlier work on technology workers [5]. Visualizations like Ariadne *show* end-users people who actively work with technology artifacts, effectively removing the initial communication overhead. Social network analysis metrics can be used to automatically identify key individuals or groups of individuals with similar knowledge of and experience with technology.

Ariadne represents another data point for researchers interested in the visualization of socio-technical relationships and their utility in organizations as well as a medium through which end-users can identify other individuals using artifacts of interest.

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7. References

[1] Card, S.K., J.D. Mackinlay, and B. Shneiderman, *Readings in Information Visualization: Using Vision to Think*, Morgan Kaufmann Publishers Inc., San Francisco, CA, 1999.

[2] M. Cataldo, P.A. Wagstrom, J.D. Herbsleb, and K. Carley, "Identification of Coordination Requirements: Implications for the Design of Collaboration and Awareness Tools", In *Proceedings of the 2006 20th Anniversary Conference on Computer Supported Cooperative Work*, ACM, New York, NY, 2006, pp. 353-362.

[3] C.R.B. de Souza, S. Quirk, E. Trainer, and D.F. Redmiles, "Supporting Collaborative Software Development through the Visualization of Socio-Technical Dependencies", In *Proceedings of the 2007 International ACM Conference on Supporting Group Work*, ACM, New York, NY, 2007, pp. 147-156.

[4] S.G. Eick, J.L. Steffen, and E. E. Summer, Jr., "Seesoft-A Tool for Visualizing Line Oriented Software Statistics", *IEEE Transactions on Software Engineering*, IEEE Press, Piscataway, NJ, 1992, 18(11), pp. 957-968.

[5] M. Gantt and B. Nardi, "Gardeners and Gurus: Patterns of Cooperation Among CAD Users", In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, New York, NY, 1992, pp. 107-117.

[6] Stasko, J.T., J.B. Domingue, M.H. Brown, and B.A. Price, *Software Visualization*, MIT Press, Cambridge, MA, 1998.

[7] E. Trainer, S.Quirk, C.R.B. de Souza, and D.F. Redmiles, "Analyzing a Socio-Technical Visualization Tool Using Usability Inspection Methods", In *Proceedings of the IEEE Symposium on Visual Languages and Human Centric Computing*, IEEE Computer Society, Washington, DC, 2008, in press.

[8] Wasserman, S. and K. Faust, *Social Network Analysis: Methods and Applications*, Cambridge University Press, Cambridge, UK, 1994.