PROFILING THE EFFORT OF NOVICES IN SOFTWARE DEVELOPMENT TEAMS

An Analysis using Data Collected Non Invasively

Ilenia Fronza and Jelena Vlasenko

Free University of Bolzano – Bozen, Piazza Domenicani – Domenikanerplatz, 3, I-39100 Bolzano – Bozen, Italy

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Abstract: New developers exhibit working patterns that are different from existing and experienced software developers. Understanding such patterns may help in determining the actual level of introduction developers have within a company. Moreover, browsing the internet has achieved a pivotal role, as browsing people collect valuable information about working issues and, indeed, developers spend a significant amount of effort browsing. Models have been proposed and validated for the introduction of novices in companies. This paper analyses one of the most promising of these models, the one proposed by (Fronza et al., 2009), and validates it against the patterns of usage of browsing. It appears that the patters of use of the browser confirm the proposed model and that at the end of the observation period, when according to the model, the new developers should have been fully introduced into the working patterns of the company, there is a substantial congruence between the working patterns of the new developers and of the existing developers.

1 INTRODUCTION

It is widely known (Brooks, 1995) that novices may slow down progress if not bring it to a complete stop while they are brought up to speed. Despite of that, important opportunities may be missed in software industry if the team cannot increase the rate at which novices complete functionality (Ronchetti et al., 2006; Wei and Tai, 2010). In order to become productive novices need to learn, just to give some examples, programming languages, tools, development processes, team dynamics, and coding standards. The analysis of novices activities can propose early insights on their integration in the team. To date, there is a lack of evidences coming from industrial teams, and analysed data are mostly collected using time consuming and error prone techniques (Sillitti et al., 2005).

In this work we address these issues by analysing novices integration in an industrial team of professional software developers. We use data collected by an AISEMA system (PROM) (Coman and Sillitti, 2007; Coman et al., 2008; Coman et al., 2009; Scotto et al., 2006; Sillitti et al., 2003; Sillitti et al., 2004) to:

- Compare novices and experts tool usage;
- Find the purpose of novices browsing activity.

We noticed that the developers, both experts and novices, devoted a significant part of their effort to the 3 following tools: Visual Studio, Outlook, and Browser. There are no doubts about the purpose of using Visual Studio. Moreover, we know that the developers get their requirements and tasks via e-mail what explains the effort devoted to Outlook. Still, it is unknown what the developers do when they browse. We assume that the developers use Browser because of two reasons: browsing for business purposes and browsing for private purposes. We extracted keywords from headers of visited web pages to assess whether the developers were browsing for business or private purposes.

The analysis is performed for each of the four integration phases proposed in (Fronza et al., 2009), where developers interactions caused by Pair Programming (PP) sessions have been analysed and a model has been proposed for describing integration of novices into a team. These four phases are: 1) initiation, 2) independence, 3) maturity, and 4) integration.

The paper is structured as follows: in Section 2, we present some related work; in Section 3, we introduce our approach. In Section 4, results are presented. In Section 5 we discuss results and limitations of this work. In Section 6, we draw conclusions and discuss future work.

Fronza I. and Vlasenko J..
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2 RELATED WORK

Novices Work. In the first period of work, novices have to learn about the problem domain and software system, and also to adapt to the new working environment (Sim and Holt, 1998). During their first period of work in a team, novices have been reported to be less efficient in looking for information and in understanding it (Zou and Godfrey, 2008), and less accurate and slower in performing low-level programming tasks. According to results in (Berlin, 1993), novices do more errors and are easily misled by unclear error messages, use a limited set of tools, wait longer than experts before asking for help, and make a more complex and error-prone plan for simple tasks.

Analysis of Tool Usage. Available works on tool usage mainly focus on examining the use of tools to improve them. (Lethbridge and Singer, 1997) analyses tools used by developers to find how to increase developers productivity. Both the studies find developers to spend most of their time navigating through source code. Therefore, the proposal is to develop new tools to ease the navigation process. (Coman et al., 2009) is one of the most recent studies. Tool usage and purposes of use are analysed in a team of three members. Each developer is found to use from 11 to 13 tools, with five purposes of usage: Documents, Navigating, Communication, Internet, and Coding.

3 STRUCTURE OF THE STUDY

3.1 Data Collection and Environment

Data for this study were collected non-invasively by means of PROM (PRO Metrics) (Sillitti et al., 2003) from a team of professional software developers working in an IT department of a large Italian manufacturer that prefers to remain anonymous. The length of the study is approximately 10 months: from October 2007 to July 2008.

The team was composed of 17 developers: 15 existing team members working for the company more than 5 years and 2 new team members who joined the team before we started collecting the data. The developers all hold university degrees in computer-related areas and have programming experience from 10 to 15 years.

3.2 Data Analysis

In the first part of this study we identified all the tools that were used by all the developers during the period of study. We found that the developers were using 26 tools. Only 9 tools were used regularly and by all the developers during the observation period: Browser, Messenger, Excel, Word, Windows Explorer, Management Console, Outlook, Remote Desktop, and Visual Studio. The effort devoted to these tools was more than 80% of the total effort.

We introduced the following formula to compare novices and experts tool usage:

$$UC = \frac{|U_E - U_N|}{\max(U_E, U_N)} \tag{1}$$

Where U_N is novices tool usage, U_E is experts tool usage, and UC (Usage Comparison) is the comparison between these two variables. We use radar plot to visualize how differently experts and novices distribute their effort among tools.

We found that the developers devoted a noticeable part of their time to browse Internet. Thus, we decided to investigate the purposes of using Browser. We assume that Browser can be used because of 2 reasons:

- Business Browsing – when the developers go to Internet to search for necessary information they need to complete their tasks
- Private Browsing – when the developers go to Internet to do their private business, i.e., internet shopping, reading news, youtube, etc.

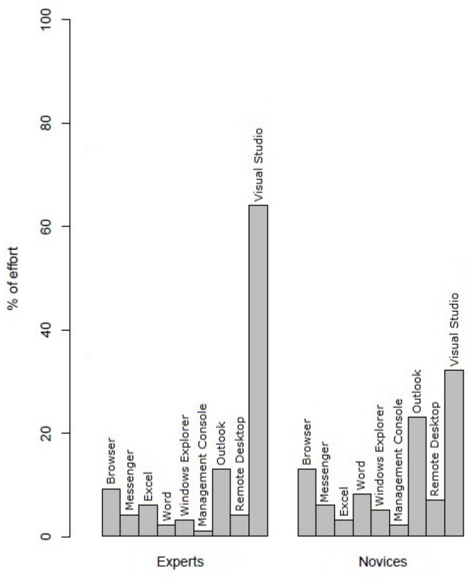

Figure 1: Distribution of effort among 9 tools.

We used headers of the visited web pages to identify a set of keywords that correspond to

Business Browsing. Based on these keywords we extracted the effort devoted to Business Browsing and Private Browsing.

4 RESULTS

Figure 1 represents distribution of effort among the 9 selected tools during a period of 10 months. We notice that the developers, both experts and novices, devote a significant part of their effort to the 3 following tools: Visual Studio, Outlook, and Browser.

To understand better how differently experts and novices use tools we compute *UC* for the four phases. Figure 2 visualizes these results.

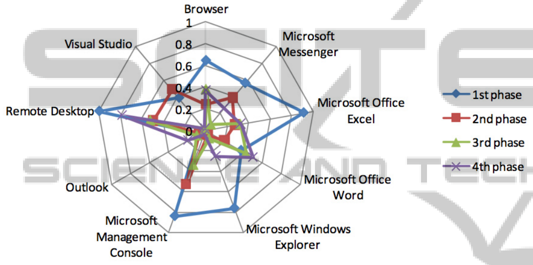

Figure 2: Comparison of experts and novices tool usage in the four phases identified in (Fronza et al., 2009).

Based on the analysis of Figure 2 we make the following assumptions:

- In the first phase, *UC* is higher than 0.5 in five out of nine tools. Thus, we can assume that tool usage is significantly different between experts and novices;
- In the second phase, *UC* is lower than in the first phase in eight out of nine tools. Four tools (Visual Studio, Remote Desktop, Microsoft Management Console, and Microsoft Messenger) still have an associated *UC* around 0.4;
- Starting from the third phase, novices begin to become more similar to experts in terms of tool usage. In particular, there is no difference in usage of Visual Studio and Outlook;
- In the final fourth phase, there is almost no difference in usage of Visual Studio, Outlook, and Microsoft Management Console. UC is still higher than 0.4 only in two tools: Remote Desktop and Microsoft Office Word;
- Browser has associated UC higher than 0.6 in the first phase; in the 2nd, 3rd, and 4th phases UC is stable and is between 0.2 and 0.4.

Considering the results from Figure 1 and Figure 2 we notice that the developers spend a noticeable part of their time browsing Internet and there is a difference in how experts and novices use Browser.

Figure 3 indicates that both experts and novices when they browse devote most of their time browsing for business purposes. Though, it can be noticed that in the 1st and 2nd phases experts devote significantly more time to Business Browsing than novices. The results may indicate that when developers go to Internet during their working time the reason in most of the cases is a lack of necessary knowledge.

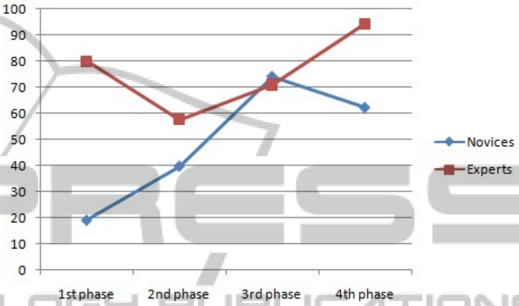

Figure 3: Percentage of novices and experts business browsing in the four phases identified in (Fronza et al., 2009).

5 CONCLUSIONS

In this study we analysed how experts and novices use tools during a period of 10 months.

We found that most time consuming applications are Visual Studio, Outlook, and Browser. We confirmed in our study the four integration phases introduced in (Fronza et al., 2009). We found that in the 1st phase experts and novices use tools in a very different way and then as time passes the difference also decreases. Moreover, we noticed that both experts and novices spend a part of their time browsing Internet.

We divided browsing into two categories: Business Browsing and Private Browsing and based on keywords extracted data to investigate how much time the developers devote to each category of browsing. We found that most of the browsing time the developers visit web pages connected to their work in order to get necessary knowledge. We assume that in this case Browser should not be counted as a distracting activity but as a part of working process.

Furthermore, we studied how usage of Browser changes throughout the four phases and noticed that in the first two phases the developers browse more for private purposes and then they start using Browser more business purposes, meaning that they start behaving similar to experts and are integrated to the team.

Overall, we think that it is an interesting topic to investigate since browsing is an activity that consumes a lot of time and its benefit is often questioned by managers.

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