Results from the 2008 Classroom Evaluation of Hackystat

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Contents

1 Methodology **2**

2 Results form Questionnaire **5**

3 Interpretation of the 2008 data **18**
3.1 Experimental Limitations . . . 18
3.2 Conclusions regarding Installation/Configuration . . . 19
3.3 Conclusions regarding overhead of use . . . 19
3.4 Conclusions regarding sharing development data with other members . . . 19
3.5 Conclusions regarding usage and utility . . . 19
3.6 Feasibility in a professional software development context . . . 22

4 Comparison to the results of 2003 and 2006 **23**
4.1 Hackystat in 2008 vs. 2003 and 2006 . . . 23
4.2 Comparison of the empirical results . . . 25
4.2.1 Installation/Configuration . . . 25
4.2.2 Overhead of Use . . . 26
4.2.3 Future Feasibility . . . 27

5 Future Directions **28**
5.1 Installer . . . 28
5.2 Performance of Ant Build Tasks . . . 28
5.3 Performance of Analysis . . . 28
5.4 Data Accuracy . . . 28
5.5 Data Presentation in SICU . . . 29

Abstract

This report presents the results from a classroom evaluation of Hackystat by ICS 413 students at the end of Fall, 2008. The students had used Hackystat v8 for approximately four weeks at the time of the evaluation. The survey requests their feedback regarding the installation, configuration, overhead of use, usability, utility, and future use of the Hackystat (Version 8)[1]. This classroom evaluation is a semi-replication of the evaluations performed on Hackystat (Version 5) in Fall 2003[1] and Hackystat (Version 7) in Fall 2006[2]. As Hackystat changed significantly between 2003 and 2006 and from 2006 to 2008, some of the evaluation questions changed as well.

The data from this evaluation, in combination with the data from the 2003 and 2006 evaluations, provides an interesting perspective on the past, present, and possible future of Hackystat. Hackystat is an completely rebuilt version, which is organized as a collection of loosely coupled software services such as SensorBase, DailyProjectData and Telemetry, which together provide better extensibility and flexibility compared to the old versions. The result shows that, though there are some regressions on installation and overhead of use, Hackystat did successfully accomplish its utility to facilitating development.

1 Methodology

At the end of the Fall 2008 semester, the students in ICS 413 were contacted by email and asked to respond to the following questionnaire soliciting their opinions regarding Hackystat. The graduate student researcher on this project (Shaoxuan Zhang, sz@hawaii.edu) provided each of the students a "secret" code. The correspondence between the secret codes and the students are only known by the graduate student, but not the instructor of the class, in order to avoid the potential for bias to "please" the instructor/designer who would presumably be gratified by positive responses to the questionnaire. Response was optional, but the students were offered extra credit points for providing their opinions. The list of names who should be awarded extra credit was sent to the class instructor without identifying individual responses. The students were asked to reply within a week. Eighteen out of the nineteen students contacted provided responses.

In addition, we log students' usage of the system, which is not aware by students, and we compare the logging data with the feedbacks from the survey.

The complete questionnaire follows:

> ***Hackystat Evaluation***
>
> *Hackystat is a long term research project concerned with improving the effectiveness and efficiency of software engineering metrics collection and analysis. Since 2003, we have periodically conducted a survey of students in ICS software engineering classes to assess the current strengths and weaknesses of the system.*
>
> *To preserve anonymity, while also ensuring that only ICS students respond and respond only once, we ask you to provide the "secret code" that you randomly selected in class. To enable credit for completing this evaluation, only the graduate student researcher on this project (Shaoxuan Zhang) will know which code corresponds to you. He will provide a list of names who should be awarded credit to the class instructor without*

[1] All future references to "Hackystat" implies Version 8; other versions of Hackystat will be referred explicit such as Version 7 and Version 6

identifying individual responses. You can also contact Shaoxuan if you want your data deleted from analysis after you've submitted it.

If you want to go back and change your responses, simply fill out the entire form again. We will discard all but the most recently submitted entry for a given code.

This survey contains 17 questions and we expect that you will need about 10 minutes to complete it.

Thank you very much for your help! We take your views very seriously: prior responses to this survey have led to far-reaching changes in Hackystat.

Before filling out this questionnaire, you might want to take a look at the following image for the Software ICU to refresh your memory:

http://csdl.ics.hawaii.edu/~johnson/portfolio.gif

* Required

1. *Installing the Eclipse IDE sensor was: **
   - *Very Easy*
   - *Easy*
   - *Neither easy nor difficult*
   - *Difficult*
   - *Very Difficult*
2. *Installing the Ant sensors (JUnit, SCLC, Emma, etc.) was: **
   - *Very Easy*
   - *Easy*
   - *Neither easy nor difficult*
   - *Difficult*
   - *Very Difficult*
3. *Please provide any feedback you can on the problems you experienced during sensor installation and server configuration, as well as any suggestions you have to make this easier in future.*
4. *The amount of overhead required to collect Hackystat data (after successful installation and configuration of sensors) was: **
   - *Very Low*
   - *Low*
   - *Neither low nor high*
   - *High*
   - *Very High*
5. *The amount of overhead required to run Hackystat analyses was: **
   - *Very Low*
   - *Low*
   - *Neither low nor high*
   - *High*

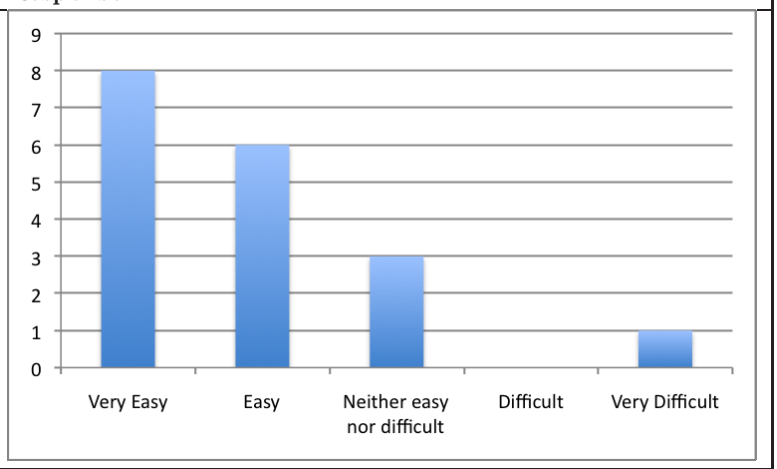
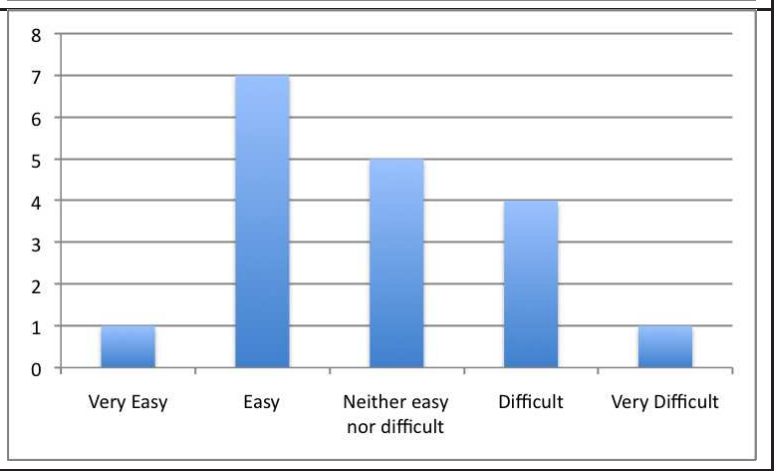
- *Very High*

6. *Please provide any feedback you can on Hackystat overhead, as well as any suggestions you have to reduce the overhead in future.*
7. *Did you encounter any problems while collecting data? Was there any kind of data that you failed to collect? If yes, please explain.*
8. *How did you feel about sharing your software development data with other members of the class? **
9. *How frequently did you use the telemetry page? **
    - *Every day or more*
    - *2-3 times a week*
    - *Once a week*
    - *Less than once a week*
    - *Never*
10. *If you used the Telemetry page, what were you trying to find out?*
11. *How frequently did you use the Software ICU? **
    - *Every day or more*
    - *2-3 times a week*
    - *Once a week*
    - *Less than once a week*
    - *Never*
12. *If you used the Software ICU, please check the vital signs that were useful to you. **
    - *Coverage*
    - *Complexity*
    - *Coupling*
    - *Churn*
    - *Size*
    - *DevTime*
    - *Commit*
    - *Build*
    - *Test*
    - *None of the above*
13. *Did you feel the Software ICU colors accurately reflected the "health" of your project? If not, why not? **
14. *Were you able to use the Software ICU to improve your software's quality and/or your team's process? If so, in what ways? If not, why not? **
15. *Please provide any other feedback you would like regarding Telemetry and the Software ICU, as well as any suggestions you have on how we can improve the system.*

16. *If I was a professional software developer, using Hackystat at my job would be: **
    - *Very feasible*
    - *Somewhat feasible*
    - *Neither feasible nor infeasible*
    - *Somewhat infeasible*
    - *Very infeasible*
17. *Please provide any other feedback you can on the feasibility of Hackystat in a professional setting, as well as any suggestions you have on how its feasibility could be improved.*

2 Results form Questionnaire

This section presents the responses from the respondents to each of the questions. For the "short answer" questions, I corrected misspellings and minor grammatical errors to improve readability.

Question	**Response**
1. Installing the Eclipse IDE sensor was: • Very Easy • Easy • Neither easy nor difficult • Difficult • Very Difficult	
2. Installing the Ant sensors (JUnit, SCLC, Emma, etc.) was: • Very Easy • Easy • Neither easy nor difficult • Difficult • Very Difficult	

3. Please provide any feedback you can on the problems you experienced during sensor installation and server conguration, as well as any suggestions you have to make this easier in future.

- I could not figure out what step makes a .hackystat directory. My .hackystat directory automatically generated in my Documents and Settings directory which has a blank space in directory name. I am still not sure how to move this folder to other. The installation of all sensors was pretty well described at the project homepage and there was no problems I have met during the installation.

- Both the installation and sending sensor data was easy. However, tracking down whenever there is a problem with the sensor is not so easy. A troubleshooting page in the near future?

- Installing the sensors was pretty straightforward. I didn't have any problems.

- Case sensitivity was one problem between user and Hackystat, but it was fixed.

  If it is possible to have a .EXE that will automatically create environment variables and also install files into a local directory will be awesome.

- I did have one small hang up when installing the Ant sensors: If I remember correctly I was getting a NoClassDefinition error whenever a sensor ran. I was running java 1.5. I fixed it by downloading the jaxb libraries since the errors were referring to that. It could be not related to jaxb at all, but it worked after that. Otherwise, I had no problems whatsoever installing the sensors.

- Everything went smooth with the instructions given and the verification after each step.

- Personally I didn't run into any problems but some of the other students did. The sensors aren't difficult to install per se, but there are a lot of steps involved and it's easy to get lost while installing them. Maybe an automated installer can be created that searches for the Ant tools (maybe the user can provide a search directory) and will configure and install the sensors for the user.

- What made it hard was that all the instructions were not in one page. I had to go from one page to another and then to another. There should be instructions from STEP 1 to the end and provide proper links to the step by step process.

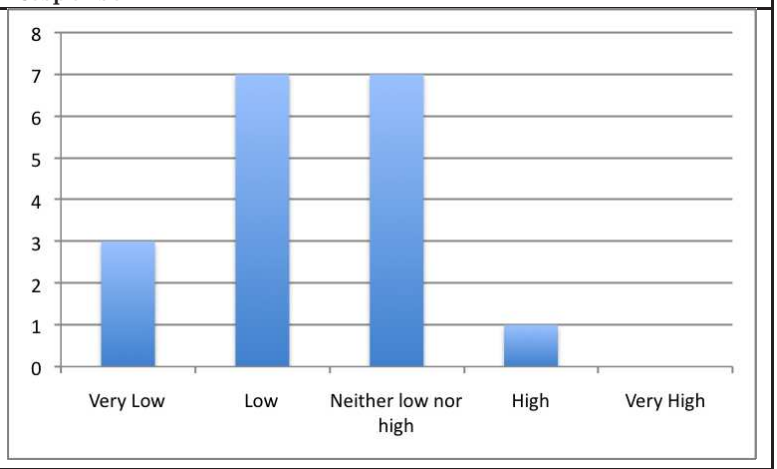
- First of all, the manual is too long. I do like your goal to analyze the software project, but if it wasn't required by this class, maybe I wouldn't think I want to use it, because it looks too complicated.

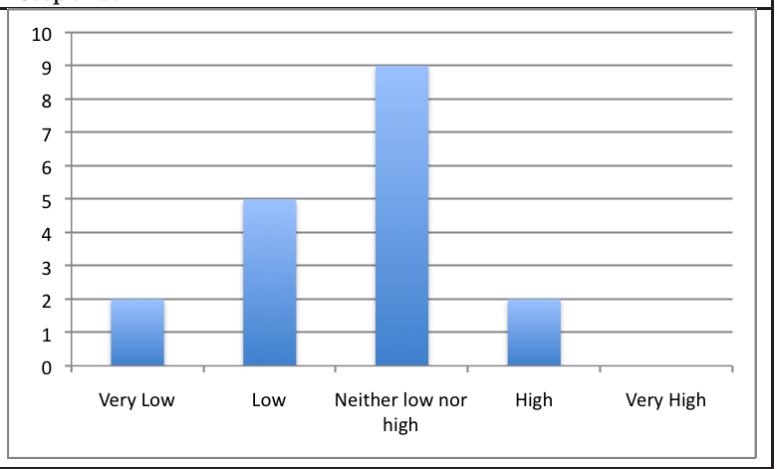
  Also there are too many things that we need to download and install. If you want to encourage people to use this more, maybe you should provide a package of all the tools somehow.

  For example, before it took a long time to install Apache, MySQL, PHP, and Perl, but now somebody offers a package called XAMPP, which is a combination of all of those, and entire installation finishes in 3 minutes. Something like that should be given.

- There is a lot of documentation in a lot of different places. It was confusing trying to figure out what to read in what order, and whether or not it was relevant to me.

- Some the installation instructions could benefit from "write once, use many times" as they're repetitive, which causes some people to start glossing over the instructions and then there's a couple that are slightly different and people (like me) won't notice the difference.
- The walkthrough was great, which made the installation easy.
- The only problem I had was the installation of the Ant sensor. I mean configuring it on Eclipse was easy especially when I try to run Emma, JUnit, FindBugs and all that from Eclipse it is sending stuff to Hackystat but when I checked my software ICU I didn't have any data on Build (all it says was N/A). And little did I know that when you run the ant sensors on Eclipse it only registers all the data to Hackystat JUnit, Emma, Checkstyle and such except BUILD. And I was told that running the BUILD on the command line works but not on Eclipse. So I tried that and YES that works. So is there a way to make it work on Eclipse when you run all the Ant sensors and it sends all the data to Hackystat including the BUILD data?
- When we ran the svn sensor, the build would fail if there are any commits from members not identified in our local Usermap.xml. Instead of looking for all commit records from all users within 24 hours, perhaps it could filter out and only look for records inside our UserMap.xml.
- The installation documentation must be read carefully. It may be easier to create a hackystat.build.xml with all the build targets, then import that file into each *.build.xml and call the sensor from the tasks.
- The most challenging sensor to get up and running was the SVN sensor. Other than that, the others seemed fairly easy to install.

Question	**Response**
4. The amount of overhead required to collect Hackystat data (after successful installation and configuration of sensors) was: * • Very Low • Low • Neither low nor high • High • Very High	

Question	Response
5. The amount of overhead required to run Hackystat analyses was: * • Very Low • Low • Neither low nor high • High • Very High	

6. Please provide any feedback you can on Hackystat overhead, as well as any suggestions you have to reduce the overhead in future.

- Since the verify command runs all the tests, I'd think that it should send data for all tests run. Rather, in the portfolio analysis, the Unit Test portion only retrieved data for any JUnit builds that were run. It doesn't really make sense why we'd have to run it separately when verify does it anyway.
- If I am correct, overhead - the processing time required by a device prior to the execution of a command. Then it all depends on what computer the user is using, I am using a single-core processor laptop it did not take long.
- Since Dr. Johnson provided us with Ant sensor examples, it was quite easy to set up everything to send data to the sensorbase. I did the hackystat tutorial and everything worked fine. However, I missed the part about creating a usermap.xml file for the svn sensors through Ant. That confused me a bit later on but I figured it out.

  What made getting data quite easy as well was having Hudson installed on a dedicated continuous integration server. Daily builds would auto-send data to Hackystat and this made it super easy to get daily info.
- The sensors ran automatically and it was fast with sending the data.
- Maybe there can be a link on http://dasha.ics.hawaii.edu to both the Hudson and Hackystat server, that way we don't have to memorize the port numbers. Also, allowing us to create an account and password would go a long way towards usability. I had to put the Hackystat login information in a text file because I can't remember a randomly-generated string for the password.
- Sending sensor data was often quite slow. Generating reports in the web application was sometimes also slow – the page wouldn't load until you refreshed it.
- The overhead to collect data was generally small, however long enough that would generally run multiple (DOS) terminals so that I could continue working while it was sending data. Analysis was no overhead since that was just pulling up a browser page.

- When sending hackystat data, it was fairly quick on my computer, MacBook Pro. Tho, there were some students I saw which had a LONG wait time on the same laptop.
- I love Hackystat! It is a very great tool especially for a developer like me.
- Since Ant takes care of running Hackystat sensors, this made it very easy to accomplish.

7. Did you encounter any problems while collecting data? Was there any kind of data that you failed to collect? If yes, please explain.

- I had a problem with sending commit data to hackystat when I worked on a group project. That was because I did not update my sensors to newer version.
- At first during the implementation of DueDates 2.0, it was not collecting commit data from my account. It was due to the account on hackystat, it included the @gmail.com part of my gmail account. So it was not matching up with each other, the hackystat account and my gmail account.
- Running an analyses on my machine was slow, it would take over 3 minutes to run a build. I am not sure why it took so long to send the build data so I can't make a suggestion.
- Only JUnit data as mentioned previously.
- Case sensitivity was an issue at first, but it was corrected so I did not get problems after that. Hudson did not send to Hackystat number of commits, but that was fixed after a little modification with build.xml file.
- I was lucky. I rarely had any problems collecting data during all the time I worked with Hackystat. The one time something got screwed up was with my development time for one day. It said 0 when I checked and I had put in a bunch of time that day so it should have said otherwise.

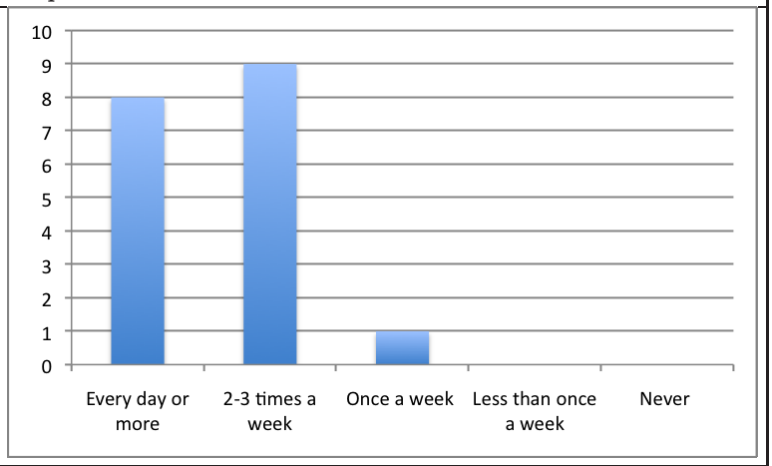
  I don't remember exactly but, that night I believe had worked in eclipse till after 12 at night, so it went to the next day before I closed the program. That could possibly be a reason for the missing data initially. The next day I just cleared the cache and it was all fine.
- There was a small issue when I first started collecting data, but it was quickly corrected when checking the xml files.
- Personally I ran into no problems collecting data.
- Sometimes it didn't collect build data for some reason.
- Occasional problems with SVN collection, I think, was a bit hard to tell.
- Everything was great except collecting data for my BUILD (please refer to above statement for more detailed problem regarding this). Thank you.
- I did with commit records but it was my fault. I wish subversion with Google Project Hosting would be more strict. I was able to check out the project with or without the "@gmail.com" suffix (i.e. "test" and "test@gmail.com"). Thus making me two different authors.

- Yes, the build data. I needed to set more environmental variables.
- For some unknown reason, my user name picked up the @gmail.com, so both my user name with and without @gmail.com needed to be added to the projects.

8. How did you feel about sharing your software development data with other members of the class?

- We could see how other groups were doing by sharing our software development data with other people. We also could find out what kinds of problems with our project by comparing graphs with other groups and this helped a lot.
- I was not offended if it was low, and I was quite intrigued with others data.
- I did not have a problem with sharing data with other people in class. I thought it was needed tool to keep tabs on everyone to assure they're doing their fair share.
- It felt good if your data was better than others. And if it wasn't, then you felt bad.
- Did not really like it because it is showing my programming habits, like starting on a project on the last couple of days.
- I felt alright about sharing my data with the class. It was interesting for me to see how other people worked on stuff. Some were consistent and others were not. Some people spend a lot of time working on stuff yet do not commit as much as others that work half the time. I think its good to see this data.
- I am okay with sharing my data.
- I didn't think it was a particularly good idea because it then forces group members to become competitive with each other, especially if one person is able to put in more time than all the others. Also, the data doesn't reflect the amount of work put in, maybe someone spent 5 hours doing research and only 1 hour programming, but the sensor data will only show 1 hour of development time and a minor code commit, versus someone who, say, just changes around the package structure for 3 hours and has a huge commit amount.
- Actually hackystat (or hacky-stalk as what my teammates and I called it) caused a lot of arguments and trash talk. Some guys were more concerned about collecting stats on hackystat than actually finishing the project. Some members would start competing on who had more commits or move development time. The project turned out to be more of a competition of stats, which wasn't healthy for the team at all.
- It will be obvious that who worked on the project, so it is nice in terms of grading students. At the same time I feel some pressure that I need to work on the development, so if team leader require everybody to work well, this is good.
- Didn't really care.
- I had no problem with this, and it encouraged me to be aware of my time management and coding style.

- It was good in a sense that they can help you with test cases and coverage.
- It was fun..because you can see how everyone is doing within your group.
- Before taking this class, I didn't think that there was a way to track software development process. After learning about software continuous integration and working in a larger group project, I have a better insight in sharing the development process. I feel that it is a must in every software development environment, big or small to be able to communicate frequently and effectively.
- I was nervous because certain individual of the class seemed able to put in ridiculous long hours. I was concerned my amount of time (which seemed reasonable) would make me look as though I'm not working as hard.
- Good, I can see how I and others rank with each other.
- I am fine with this. All group projects in all schools (e.g., Architecture) should be required to use such a system. This is great for facilitating fair evaluations of students who participate, and those who 'get the grade' by riding on the laurels, blood, sweat, and tears of others.

Question	**Response**
9. How frequently did you use the telemetry page? * • Every day or more • 2-3 times a week • Once a week • Less than once a week • Never	

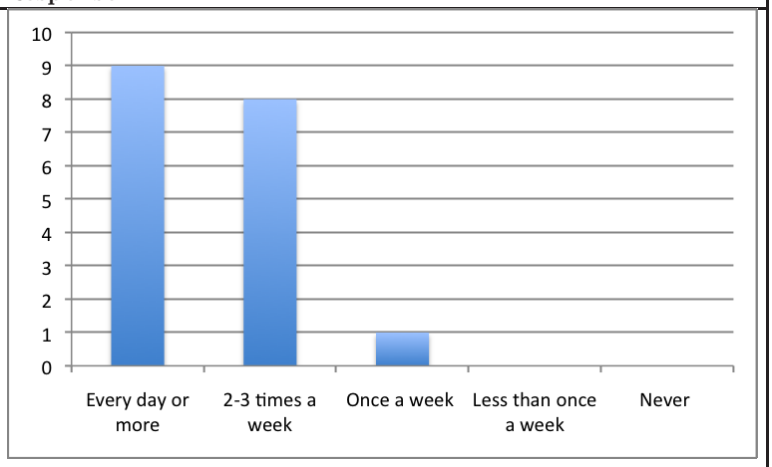
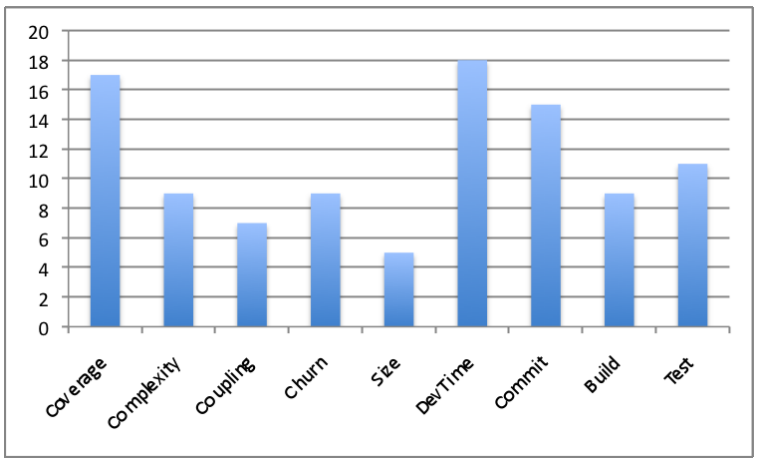
10. If you used the Telemetry page, what were you trying to find out?

- I tried to find out how was I doing for the project by looking hackystat data.
- Seeing how much time i spent on the development of the program, and also others in my group.
- When I used the telemetry page I was trying to find out if I was on par with other groups members in terms of development, build, and commit numbers.
- Whether or not, my sensors were reading, and the work output of my group members (especially on days we didn't meet together).
- If my development time was up to par with my team members.

- I usually used the telemetry page to evaluate how my team was working overall, and what my part was in that data. I also checked it to make sure everyones data was being sent.
- It helps me see how I measure up with my partners.
- Member dev time mostly, to compare the amount of development time I put in vs. my group members.
- It supposed to show us how healthy individuals are in the group. So if one person is slacking, the members need to tell him to step it up. It wasn't used that way in our group. One person really wanted a good grade for the class so he just used the telemetry to watch himself; making sure no one gets more builds/devTime/commits than him (yes he said "i need more dev time because i need an A"). I remember we had dinner as a group and one of our group members didn't go to dinner. another group members then said "oh if he ups his stats more than mine, tomorrow I'm gonna hack all day."

  Sad, but true.
- member commit, member dev time
- Curious about trends in dev time, commits.
- Usually MemberDevTime, MemberBuilds, and MemberCommits. Basically just seeing how everyone was progressing.
- graphs, line trends of other group members
- My status and the status of our group and make sure everyone is doing their part.
- Mostly trends in individual performance, as well as overall project outlook.
- Basically if everyone was putting in the same amount of effort. Also it helped indicate if everyone is on track. If they have regular activity, then the chances of them on track is higher.
- Was the coverage, complexity and coupling getting bad?
- I tried to review each telemetry page daily to understand what I could do to improve the project health and focus efforts.

Question	**Response**

Question	Response
11. How frequently did you use the Software ICU? * • Every day or more • 2-3 times a week • Once a week • Less than once a week • Never	
12. If you used the Software ICU, please check the vital signs that were useful to you. * • Coverage • Complexity • Coupling • Churn • Size • DevTime • Commit • Build • Test • None of the above	

13. Did you feel the Software ICU colors accurately reflected the health of your project? If not, why not?

- I felt most of colors accurately reflected the health of the project. For the Coverage data, since we can write test cases just for increasing of the rates, we cannot assume that the project is in healthy condition even if the coverage data displayed in green color. However, I think this is not a problem of hackystat.
- Yes
- The only issue I had with the ICU colors was with the coupling. In both versions of DueDates we had to add extra classes at the last minute which would cause the coupling ICU to turn red. I am not sure how to address that because the coupling does need tracking.
- Not really, I don't think having a high churn amount is necessarily bad. Of course, it's a case-by-case thing. For my group, it wasn't about not committing frequently; we were just rehashing code because something just didn't work.
- Yes, reflected accurately on the health of the project. Showed how much coverage we had.

- I feel that the Software ICU did accurately reflect the health of my projects. For Due Dates 2.0, which was a longer project, the data was getting increasingly more meaningful as the trends were over a larger period of time. It is good to look at things like devtime, commits, coupling, and coverage to see the color and the past trend because i think they really say something about the current state of the project.

  To make it simpler, whenever I knew our project wasn't doing good and people weren't working regularly, the software ICU would have lots of reds and yellows. When I knew the project was doing better and people were working regularly, there were greens. It makes sense.

- The ICU was accurate with our project because it showed drastic spikes in all signs. This reflects our project in poor health.

- Not particularly because a project's health cannot easily be determined by just measuring numbers alone. For example, it's easy to increase coverage, but if a class has nothing but getters and setters and a toString method, does it really need to be tested? Of course not, but someone might feel compelled to do it in order to increase coverage and get a better health, but it's just a waste of time in my opinion. Also, DevTime is only measured from Eclipse but that doesn't measure things such as someone reading a book or looking up websites for information. It only measures active development in one program, forcing people to only use whatever IDE's Hackystat supports. The figures for complexity and coupling are hard to evaluate too. We want complexity to be low but sometimes it's unavoidable for it to be high, and should Hackystat show an absolute cut-off point where the complexity must be below a certain point for the project to be considered acceptable? Coupling is another one that falls under this category, if your program relies on a lot of outside libraries, can someone really determine an absolute value that the project's coupling must be under?

- Yes.

- maybe

- Coverage: perhaps too sensitive to drops/bounces in coverage. Churn: while you're working on a project, churn is going to vary, sometimes a lot. The trend colors were not helpful.

- Yes, I felt it was a relatively healthy project, and this generally showed, in the end. In the first half the colors reflected not as health of a project, which I'd agree as well. I'm not sure rising coupling was entirely a bad sign as things went along and functionality was added, as it was a slow steady rise.

- Sometimes. Hard to determine what will fall into green, red, or yellow.

- Yes definitely.

- It somewhat reflected the quality of our project. Maybe in some dark corner something is not thoroughly being depicted through the colors. Perhaps a suggestion is to use different color hues.

- Yes it was pretty accurately reflected.

- No, since I did not correctly configure the sensors.
- This is subjective... Usually the colors were spot on, however, they are quick to turn one way or the other depending on events that are being managed by the team (e.g., large code churns due to removal of unused code/imported code, etc.).

14. Were you able to use the Software ICU to improve your software's quality and/or your team's process? If so, in what ways? If not, why not?

- We can check how other members are doing for the project through the Software ICU and this helps a lot especially when we are working on the team project.
- Yes, for tracking if members were working on their tasks. Also how complex the program is increasing or decreasing.
- In my opinion, it is not clear if the ICU improved our system. Because other tools such as junit, findbugs, and pmd was easier to use to improve the application.
- If anything, keeping an eye on coverage helped us look out for what was being tested and what wasn't. Yes, showed how much coverage we had, and improve on that.
- I think for sure the Software ICU improves team process. More than just keeping people "in check" when grades are at stake, it provides an accurate way to assess what's being done and by whom. Our team got a lot out of checking up on the software ICU and assessing our team process. It seemed to get better over time.

  As far as the software's quality, I think the Software ICU could be very useful in improving this. If my project for instance was in the red for complexity and coupling, and there were some code issues, I could see all this automatically through hackystat. Besides coverage stats though, my team did not really use the ICU to improve the software's quality.
- ICU was able to help us because it told us what needs to be focused or corrected.
- Personally, I only found Hudson useful because it's like running your code on someone else's computer to see if your environment is set up differently from a generic machine. I feel that the data for Hackystat is more something to look at out of curiosity rather than something to determine how well a project's status is because it's hard to base a project's health based on numbers alone and it might put unrealistic pressures on the team to make the project healthy for Hackystat when they can better spend their time developing instead.
- Yes.
- Yes, coverage tells me if we didn't write enough test cases.
- No. Coverage: already aware from Emma. DevTime, Commit, Build, Test: either team members did not look at the statistics, or they didn't care, because their habits did not change much. Others: not much we could do about the other statistics.
- Yes because able to manage our time and development fairly equally, and also notice spikes indicating bigger changes or problems.

- Yes, shows were we could improve as a group and improve as a programmer.
- Like in my case last time, I saw on Software ICU that I don't have a data on my BUILD. So because of that information I know what the problem is and it helped me to find a solution and figure everything out before it is too late.
- Our project ICU definitely described our lacking and late attempt to improve coverage. Due to the ICU, we were able to distinguish this fact quick and easy.
- The amount of activity helped us identify who was falling behind. Without offending our members by outrageously claiming their not working, we could tell by the sensors. Members can be more self-critical by looking at their individual data compared to the groups.
- Yes, by checking the coverage, complexity and coupling.
- Yes. By targeting coverage, dev time, coupling, and complexity, my team was able to improve all these into areas that were acceptable to us.

15. Please provide any other feedback you would like regarding Telemetry and the Software ICU, as well as any suggestions you have on how we can improve the system.

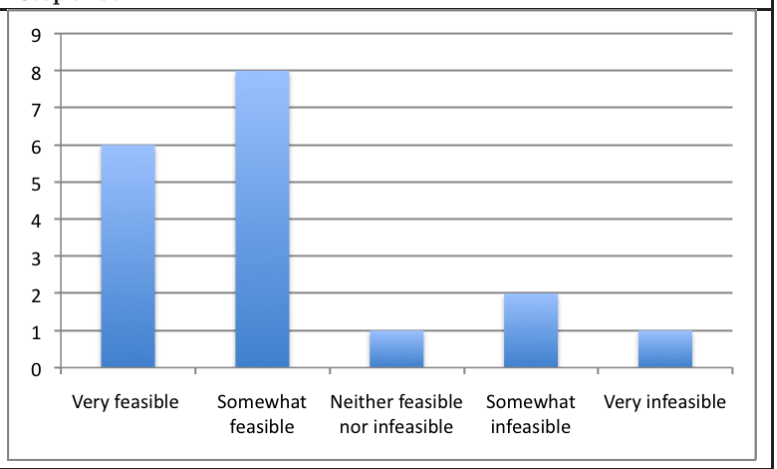
- I do not think the commits, builds, tests should be colored in because it all depends on how much the user does on the project. Is it possible to show line coverage instead of method coverage? The software ICU and telemetry was awesome tools in helping out with the project. It gave me visual stats on the project.
- What I think would be cool is to implement something to view the trend for each category in larger format but in the same style as the software ICU. I know this is shown on the telemetry page when you select it to show. However, I would be nice if there was some sort of rollover function that brought up a slightly larger window with a blown up overall trend. I can see how this isn't really needed but I would mostly likely check it a lot if it was there.

  A minor thing that I noticed when using the Telemetry page was that when I selected a new statistic to view, the page would always jump back to the top and I'd have to scroll down each time. Its not really a biggie, but it makes navigating a bit slower when your going through all the project statistics.
- Consistent colors for each members can help.
- In addition to everything I mentioned above, it might help to somehow make the sensors configurable in some way, for example if two people are doing pair programming, there should be an option to set the sensors to send data for both people. Perhaps complexity can be measured somehow to only include methods that, say, start with get or set and toString. This way people aren't forced to write pointless test cases in order to increase coverage.
- Help page should be provided inside project browser. It should describe how to use it, what telemetry, what churn is, something like that.

  Also your explanation should be simple so that people want to read it. If it is complicated and long explanation, nobody will read it.

- The different color bars and randomness might be fun and interesting, but I think having a bit more consistent scheme might be better. I would suggest if possible giving each developer a specific color that they always have during the project, either random, or chosen at the beginning.

- Does not capture development outside of Eclipse. For example, IMHO, MS Visual Studio is much better in the capacity as a web development IDE, which the dev time here was not recorded.

Question	Response
16. If I was a professional software developer, using Hackystat at my job would be: * • Very feasible • Somewhat feasible • Neither feasible nor infeasible • Somewhat infeasible • Very infeasible	

17. Please provide any other feedback you can on the feasibility of Hackystat in a professional setting, as well as any suggestions you have on how its feasibility could be improved.

- I think it's good to have this in a professional environment, cause the employer or client can check on how the progress of the program is going. With out having to make so much visits or hovering over workers.

- Cannot think of any off the top of my head. The Software ICU is already great for us programming students.

- I think Hackystat is definitely feasible in a professional setting, as long as it is supported in some way. For instance, if a team of developers is working on a project and they are all for having Hackystat manage project stats, that would be great. If, however, your the only person on your team that wants to use it, then it would be hard to send data that would assess team process.

  I could see project managers wanting to have Hackystat data to evaluate everyone's input into the project, as well as the health of the project. Hackystat, I think, is perfect for new open source projects if releases are made early and often. It could be essential to seeing the overall health of the project.

- Overall, I feel like Hackystat would be an interesting tool to gather data to look at for curiosity's sake from time to time, but it should not be used as a basis for determining a project's health or to determine something such as member contribution. The sensors can

only gather information from a few sources and these readings cannot account for a person's full contributions to a project. As for determining a project's health, I do not believe the sensor readings can provide an accurate measurement because the sensors can only measure numbers based on algorithms, but it takes a person to really determine how good the code is.

- When I start to use hackystat, I need to get password from you and then eclipse send my data to your server. Some developers might have concern that hackystat steal source code.
- I think it depends a lot on the culture of job setting. I'm not too sure, but I think I may try setting it up on my own job site, even if just for myself to see my own trends.
- It is a very useful tool to keep track the health of a project so I would say it is feasible to have it in a job.
- My only wish is that ICU's should have a feature to support pair programming. Possibly a feature to indicate to the system that two people may be working on the same problem on the same system, rather than two individual machines. You might want to call this "collaborative mode", or something along the lines of that. These settings of course should be turned on or off easily from the developer's IDE (Eclipse).
- I work in a one person shop, so it would be difficult to say how useful this would be. As a lone developer, many metrics I am very cognizant of, however, having such a system would allow me to view those statistics that I do not have a "gut" feeling for. It would be great for my boss to measure the amount of time I spend on a project however.

3 Interpretation of the 2008 data

3.1 Experimental Limitations

Before drawing any conclusions from this data, it is important to recognize the limitations of this study. Compared to the limitations associated with previous study in 2003 and 2006, anonymity is achieved, but others are still unsolved in class evaluation.

First, this data is drawn from a limited sample size of 18 students in software engineering classes at the University of Hawaii. The subjects therefore have a relatively narrow and homogeneous background in software development.

Second, the context in which they used the system was a course project. Course projects tend to be smaller, narrower in scope, and with less pressure on the developers than an industrial context. It is one thing to get a poor grade for doing a poor job, it is another thing to lose your job for doing a poor job. In addition, students are not working full-time on the system; the development project is just one assignment among several.

These are all major limitations on the external validity of the responses. They do not make the results meaningless, but rather help provide a perspective on how to gain additional evidence in future that would confirm/disconfirm these initial findings. For example, it would be helpful to deploy Hackystat in a real software company, and then gather data anonymously from the coders and managers. Other insights into future research directions will be covered in an upcoming section.

3.2 Conclusions regarding Installation/Configuration

The data indicates that eclipse sensor was easy to install. To install Ant sensors were a little more difficult. The most difficult one is the SVN sensor, which require configuring Hudson, a continuous integration engine.

A major cause of installation difficulties is the documentation. Though we provided guides for every component, some students pointed out that the documentation is too distributed and too long. Some guides are too similar such that slight differences in procedures might not be noticed. A more straightforward and brief walkthrough or even an auto installation package are desired.

Regarding the collection of data, no significant problems were reported.

Installation of the services(SensorBase, DailyProjectData, Telemetry, etc.) were not evaluated because the students are not required to configure the services. They were all using the previously installed and configured public servers.[2].

3.3 Conclusions regarding overhead of use

The overhead of collecting data and running Hackystat analyses were moderate. The comments indicate that the problem of most concern was speed, both of collecting data and of running portfolio analysis.

3.4 Conclusions regarding sharing development data with other members

Most students felt OK with sharing development data with other members. But three students had concerns that sharing development data would reveal their programming habits and introduce too much competition of statical stats, which made them nervous. It is interesting that those three students are the three with least SICU running count in Figure 3. It is reasonable to infer that they worked less harder than other students and did not want it to be noticed.

3.5 Conclusions regarding usage and utility

Figure 1, Figure 4 and Figure 3 show the data from system usage logging. We will combine it with the data from questionnaire to gain insight into Hackystat's utility. Also while comparing these two collections of data, we verify that the data is reflecting the true properties of Hackystat.

Data from system logs indicates that Telemetry and Software ICU were frequently used during the evaluation period. Telemetry is invoked much more frequently than SICU (see Figure 1 and Figure 3). The Telemetry invocation stream and SICU invocation telemetry stream are quite similar in "shape"(see Figure 1) that we can confirm drill-down feature of the Software ICU is useful and contributes to the high use frequency of Telemetry analyses.

When verifying the questionnaire responses in Results form Questionnaire against the log data, we find that the choices of question 9 and 11 are somehow ambiguous. Though "every day or more" is surely about how many days you use the analysis, "2-3 times a week" may be understood as times of invocations. Figure 2 shows data of these two interpretations. If we consider the answers as "days of use", the actual use frequencies are much lower than reported, because there are 28 days in the evaluation period but the highest number of days of use is only 18. But if we consider

[2]SensorBase: http://dasha.ics.hawaii.edu:9876/sensorbase, DailyProjectData: http://dasha.ics.hawaii.edu:9877/dailyprojectdata, Telemetry: http://dasha.ics.hawaii.edu:9878/telemetry, ProjectBrowser: http://dasha.ics.hawaii.edu:9879/projectbrowser

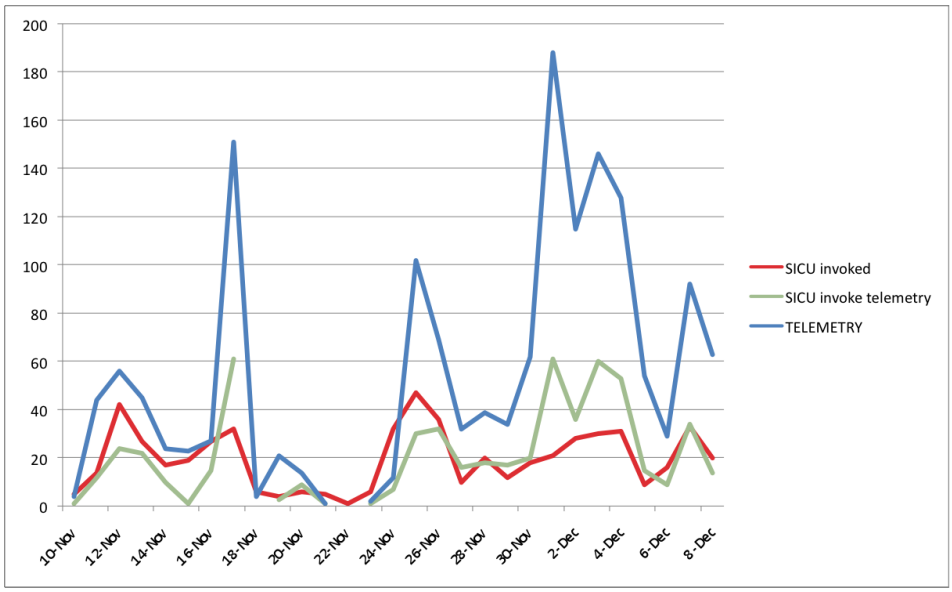


Figure 1: Usage trends of SICU and Telemetry over time

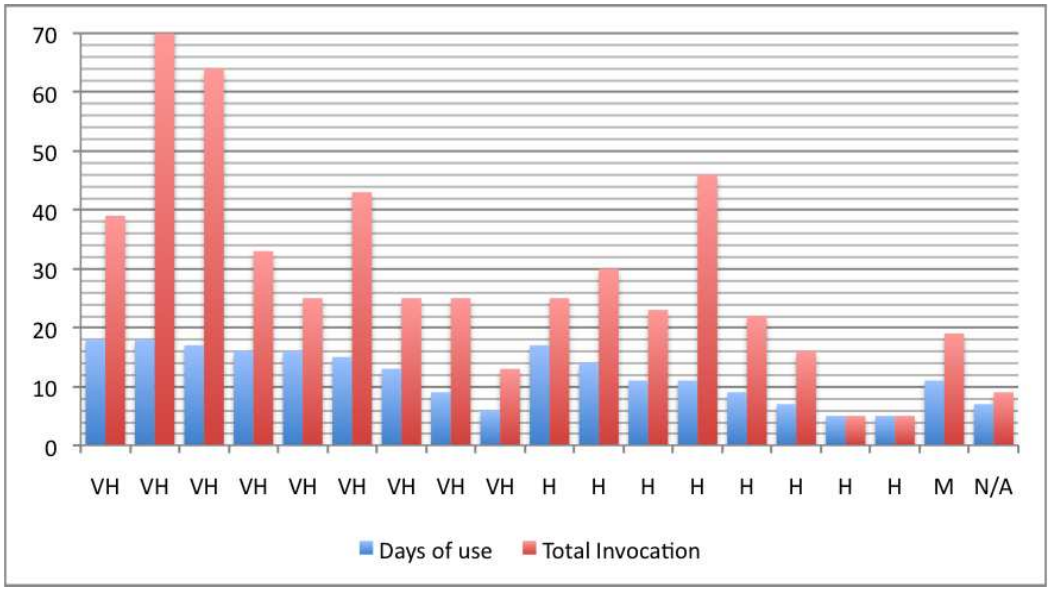


Figure 2: The count of days when SICU was used along with the total invocation on per student bias. Each pair of columns represents data of one student. The X axis shows the responses from questionnaire. VH = every day or more; H = 2-3 times per week; M = once a week; N/A = not available.

the answers as "times of invocations", the invocation frequencies are more matched to reported frequencies. However, in either case, the difference of actual usage between students who claim to use SICU analysis "every day or more" and "2-3 times a week" is not obvious. Though the total invocation times and days of the first group is higher than the second group, some students of second group two did not use SICU analysis less frequently than the students of first group. We think this error is acceptable because the frequency of use is just a remember and is not precise. So if we blur the boundary between "every day or more" and "2-3 times a week", and consider them both as "did use SICU frequently", most responses match their log data. But three of them fail the verification. Those three students claimed that they use Software ICU 2 to 3 times a week or more, but actually only half as much as they claimed.

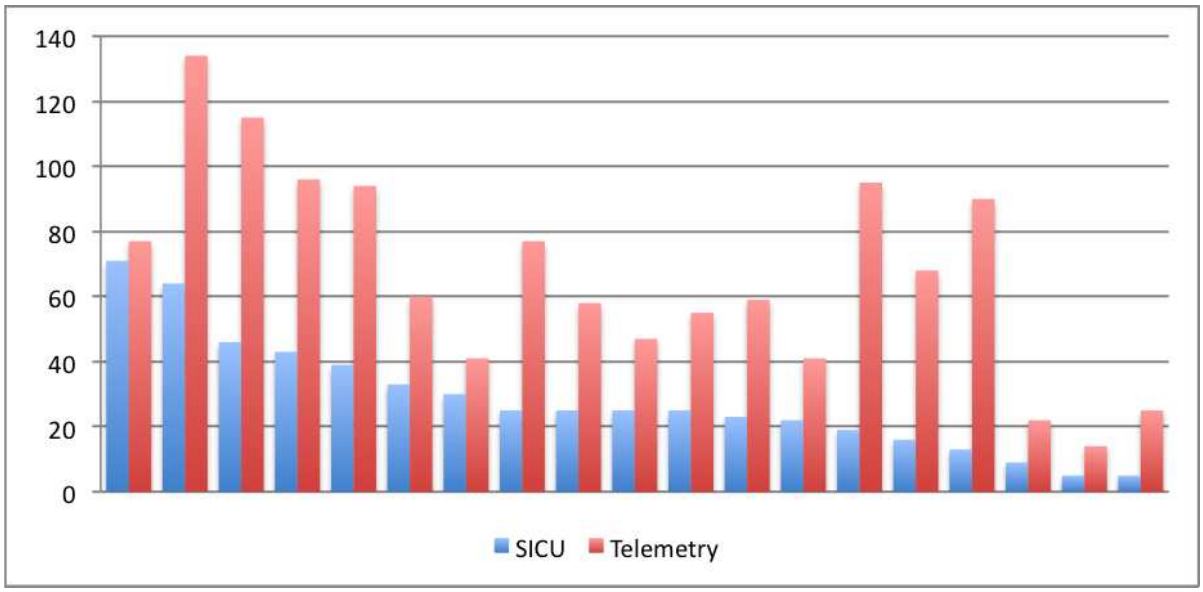
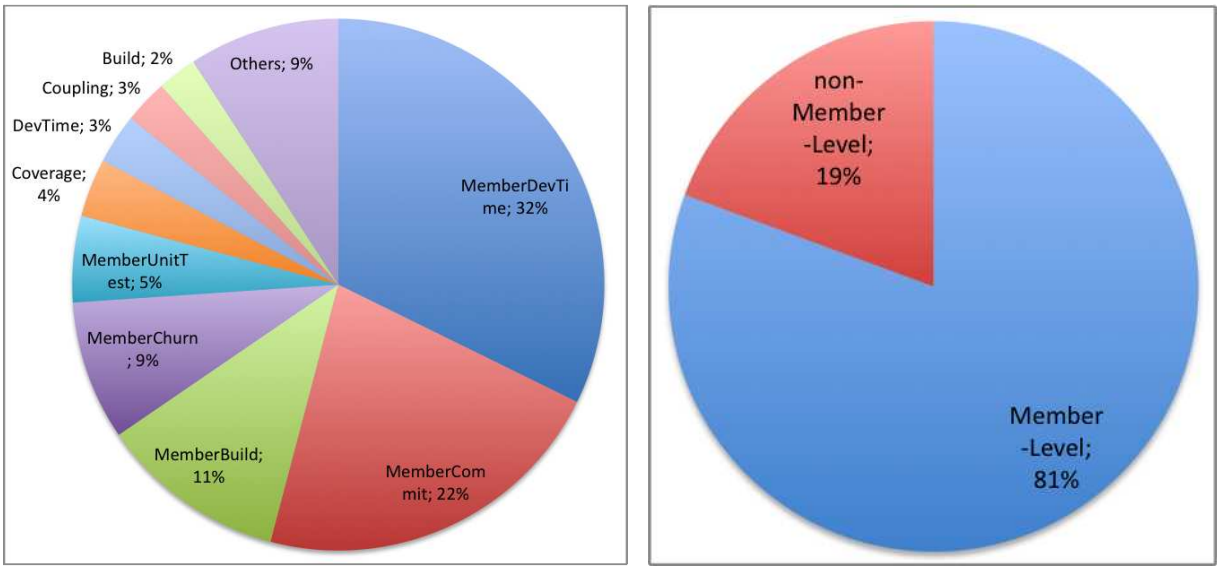


Figure 3: Analysis count on a per-student basis during the evaluation period. Each pair of columns represents data of one student.

We also find that though the reported frequency of SICU and Telemetry are similar, Telemetry's analysis invocations are in fact much more than SICU's(see Figure 3). But this matches the native of these two analyses: SICU shows the overall summary of a project's health and no need to run more than once a day, while Telemetry shows detail of a vital sign and would often be run multiple times in every use.

Both log data(4(b)) and questionnaire responses(Question 10) indicate that Telemetry is mainly used to see member level analyses, which reflect contribution of each member in the group. The two most used analyses are MemberDevTime and MemberCommint(see 4(a)). Comparing to Question 12, DevTime and Commit is the first and third vital sign and Coverage is the second. The Coverage is not of the top use in Telemetry analyses is possibly because it is enough to comprehend it from SICU and there is no member level coverage analysis.

Response of Queation 12 indicates that process vital signs(DevTime, Commit, Churn, Build and Test) abstract much more attention than productive vital signs(Coverage, Complexity, Coupling and Size). Popularity of process vital signs completely exceed all productive vital signs except Coverage. One reason of this is the comprehensive difficulty of the vital signs. The theoretical



(a) Invocations of each Telemetry analysis

(b) Comparison of member-level and non-member-level analyses

Figure 4: Usage of Telemetry Analyses

conception behind those productive vital signs create barrier to interpretation, while process vital signs are just straight-forward statistics of some development events and easy to understand. However, there is also a worried that students might paid too much attention on the "fairness" of their contributions rather than trying to make better program.

While DevTime attract most attention, its accuracy is most doubted. Currently DevTime is only collected from limited tools. DevTime data about work on other tools or doing research it is not collected. It makes DevTime highly inaccurate in measuring a member's work output, and thus sometime cause unhealthy competition within group partners. Moreover, someone might argue that work quality, rather than flat work output, is the most significant factor when measuring one's contribution.

Regarding Software ICU as a whole, 7 out of 9 vital signs are considered to be useful by at least half of the respondences and 10 out of 18 responses said the Software ICU was accurately reflecting the health of their project via colors. 4 responses disagree that was accurate because high and/or increasing Churn and Coupling are not necessarily bad. Most students thought Hackystat did help them improve their performance either in programming or teamwork or both.

We can conclude that, though there are still some deficiencies about presentation methods and potential bias of the data cause by its native or collection, Hackystat does achieve its goal to provide users useful tools to help them understand and improve their programming procedure.

3.6 Feasibility in a professional software development context

The data indicates that most students thought it was at least somewhat feasible to use Hackystat as a professional developer. Most comments indicate that Hackystat would be helpful in professional

settings. There are some arguments about the potential bias of analysis data of Hackystat that the statistical data did not accurate enough to exclusively determine a project's health state.

4 Comparison to the results of 2003 and 2006

4.1 Hackystat in 2008 vs. 2003 and 2006

To usefully compare the data from 2003 and 2006 to the data from 2008, it is necessary to understand the changes that have been made to the Hackystat system since 2006.

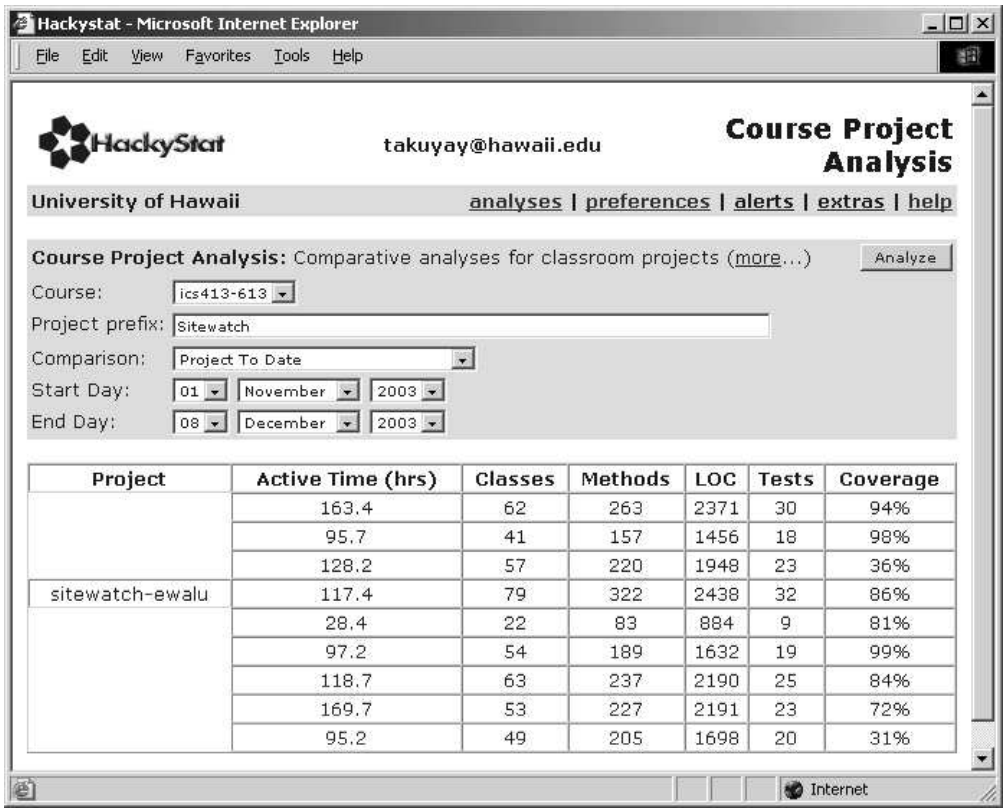
First, in 2007, the Hackystat system underwent a complete rewrite for a new major version. Hackystat Version 8 is organized as a collection of loosely coupled software services that communicate using REST architectural principles. The new architecture is much more extensible than previous versions. Upon it we built the SICU analysis, which is almost impossible in previous version because it involves large scale of data. We also built a new web interface called Project Browser, which we believe it is the best UI in Hackystat history.

Second, new sensors and metrics are introduced since 2006. Beside the seven metrics used in 2006 (Coverage, Code Issues, DevTime, Commit, Build, Unit Test, LOC), three new metrics are introduced to the evaluation: Cyclomatic Complexity(from JavaNCSS), Coupling(from DependencyFinder) and Churn(from Subversion).

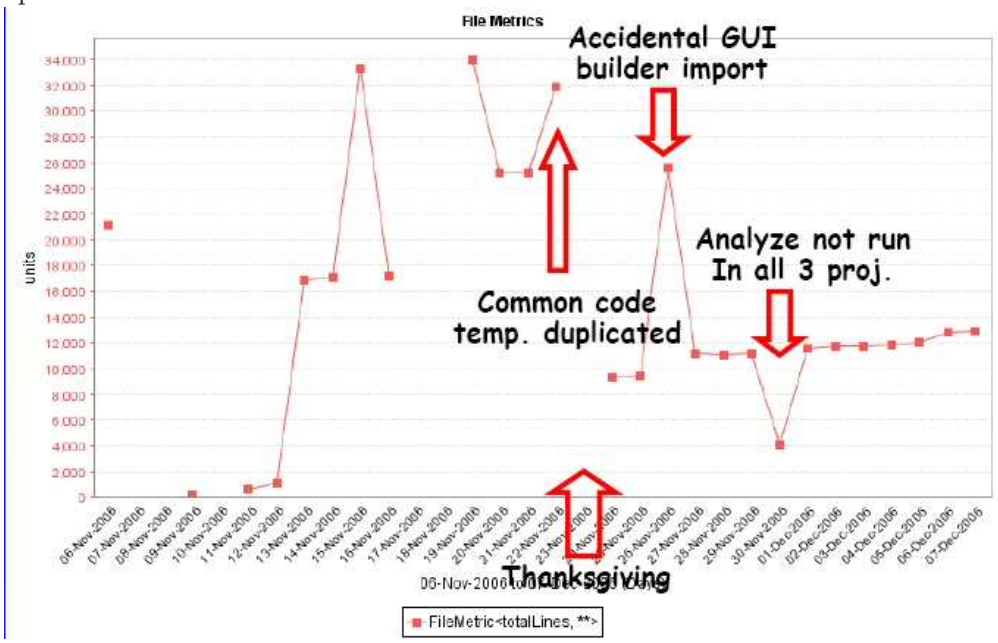
Third, the main analysis used by students are changed since 2006. In 2003, the students mainly used the course project analysis that presented summaries of the individual team project to-date metric data and the comparisons of all of the course projects. In 2006, the data was presented by the Software Project Telemetry system, which show trends over time. In 2008, the Telemetry service was still available to them. Upon it and the DailyProjectData service, we built a new service called Software Intensive Care Unit(SICU) to present the data. It combined the functionalities from the systems in 2003 and 2006 that presented both to-date data and trends of the projects. The interface, which built upon Wicket, is more user-friendly and easy to interpret.

Fourth, in 2003 the students had to manually install the sensors and in 2006, they used hackyInstaller, a GUI system, to simplify client-side installation. In 2008, because of the complete re-implementation of the system, they had to manually install the sensors again.

Fifth, in 2003, the principal analysis provided a tabular representation of "to date" values for one or more of the course projects, as illustrated below:



In 2006, the principal analysis was based upon software project telemetry. The following image shows one of approximately a dozen different charts that the students would use to analyze and interpret their collected data:



In 2008, the principal analysis was the SICU, which presented the both the to-date metric data and trends via spark-line in tabular form, as illustrated below:

Project (Members)	Coverage	Complexity	Coupling	Churn	Size(LOC)	DevTime	Commit	Build	Test
DueDates-Polu (5)	63.0	1.6	6.9	835.0	3497.0	3.2	21.0	42.0	150.0
duedates-ahinahina (5)	61.0	1.5	7.9	1321.0	3252.0	25.2	59.0	194.0	274.0
duedates-akala (5)	97.0	1.4	8.2	48.0	4616.0	1.9	6.0	5.0	40.0
duedates-omaomao (5)	64.0	1.2	6.2	1566.0	5597.0	22.3	59.0	230.0	507.0
duedates-ulaula (4)	90.0	1.5	7.8	1071.0	5416.0	18.5	47.0	116.0	475.0

In order to facilitating the interpretation of the data, the numeric data and spark-line trends are colored according to the state it represent. The Software ICU represents the first analysis in the history of Hackystat where an opinion (red, yellow, green) was being provided about the data.

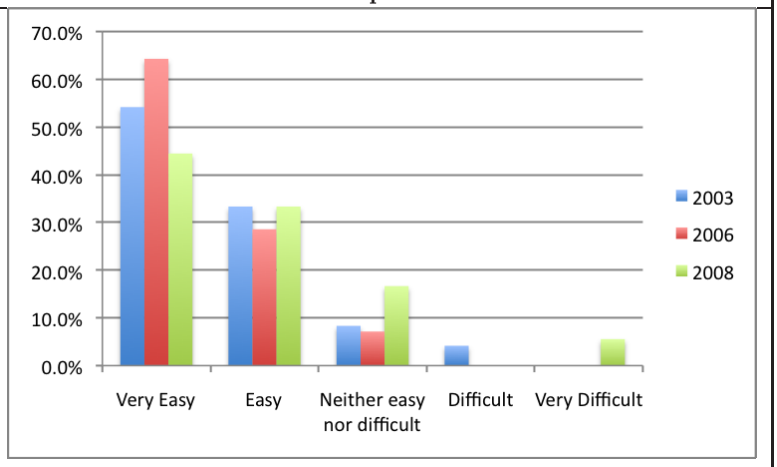
4.2 Comparison of the empirical results

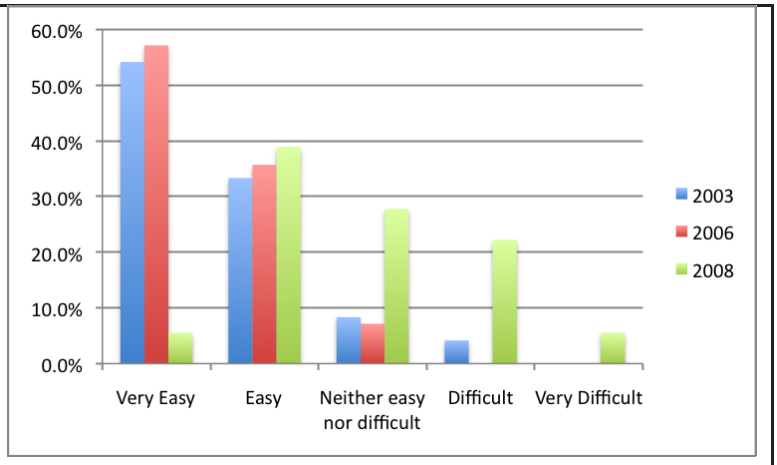
The next section presents a comparison of the data from 2003, 2006 and 2008. All data has been converted to percentages in order to support comparative analysis despite differences in the number of participants. Given the small sample size, we do not believe that statistical tests for significance are useful. Thus, any differences claimed between the data sets based upon the "shape" of the histograms are tentative and await statistical confirmation.

Only the data regarding installation/configuration, overhead of use and future feasibility are compared because the other part of the questionnaire was changed significantly from the 2006 evaluation.

4.2.1 Installation/Configuration

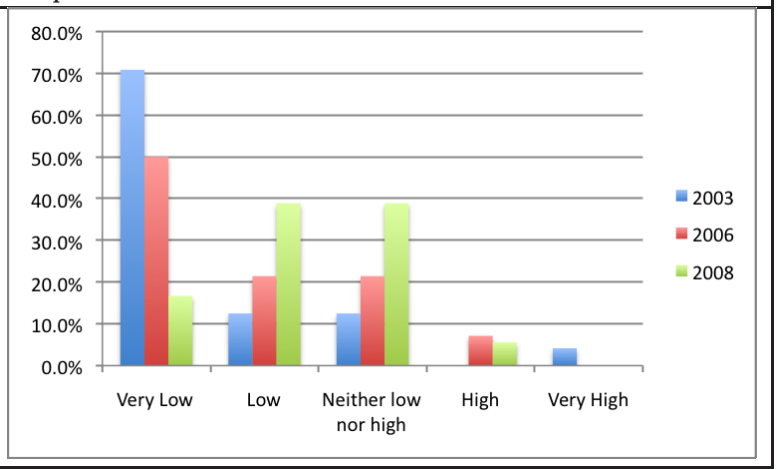
As the students were not required to configure the Hackystat services, there is no comparison of configuration difficulties in 2008.

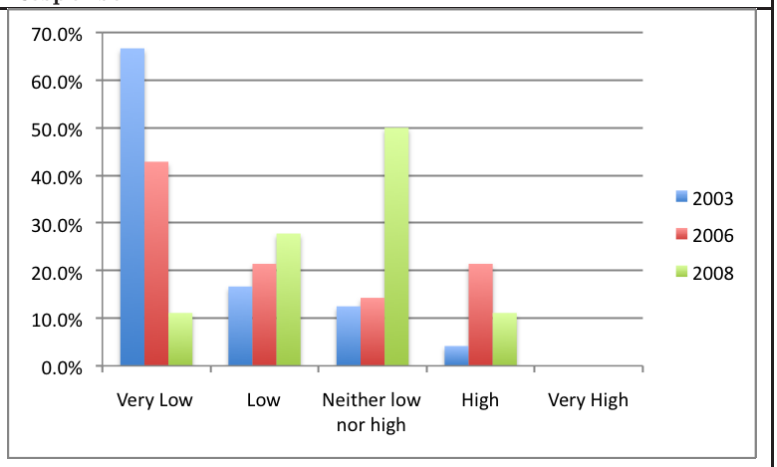
Question	Response
1. Installing the Eclipse IDE sensor was: • Very Easy • Easy • Neither easy nor difficult • Difficult • Very Difficult	

2. Installing the Ant sensors (JUnit, SCLC, Emma, etc.) was: • Very Easy • Easy • Neither easy nor difficult • Difficult • Very Difficult	

The empirical data indicates that the installation difficulties of both Eclipse sensor and Ant sensors increased in 2008, especially the Ant sensors. Compared to Hackystat in 2006, the major difference in installation is the absence of the installer. The distributed documentation instead of a single user manual is another contributor to the increase in difficulty. Finally, the setup of SVN sensor and daily build task that collects productive data involves the configuration of Hudson and thus further increase the installation/configuration difficulty.

4.2.2 Overhead of Use

Question	Response
4. The amount of overhead required to collect Hackystat data (after successful installation and configuration of sensors) was: * • Very Low • Low • Neither low nor high • High • Very High	

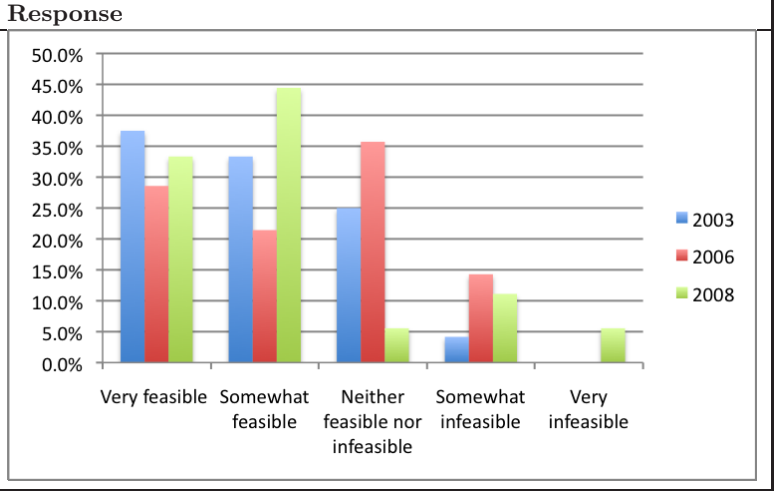
Question	Response
5. The amount of overhead required to run Hackystat analyses was: * • Very Low • Low • Neither low nor high • High • Very High	

It is surprise that the overhead of use is considered to be higher in 2008. However, the major contributor is different.

In 2003 and 2006, Ant tasks had to be executed manually everyday in order to ensure no days without data, and it was the major contributor to the overhead of collecting data. In 2008, no daily manual work is required, daily sensor data is collected by the auto daily build in Hudson. However, students complained that the execution time of Ant builds are too long and they considered this to be the major overhead of collecting data. But in fact, running Ant builds were not required by collecting sensor data. Instead, it is a part of the practice of agile development in order to verify the correctness of the code before committing to repository. It was introduced to them along with Hackystat, and this might be the reason that students got confused.

After the overhead of running Hackystat analyses increased slightly in 2006, it further increased in 2008. But there is no feedback about what factor lead to this high overhead. One of the major factors might be the processing time of SICU analysis, which usually took several minutes to finish.

4.2.3 Future Feasibility

Question	Response
16. If I was a professional software developer, using Hackystat at my job would be: * • Very feasible • Somewhat feasible • Neither feasible nor infeasible • Somewhat infeasible • Very infeasible	

The data indicates that student feelings toward "professional feasibility" increased since 2006 and was the highest among the three evaluations. It is an interesting finding because both installa-

tion/configuration difficulties and overhead of use increased since 2006. This might be a reflection of increase in utility.

5 Future Directions

As the previous section indicates, installation and performance are the major factors that stop users from adopting Hackystat to their daily development. The data accuracy and representation are also need to improve. The following sections will describe some ideas of further enhancement.

5.1 Installer

The installation difficulty is the primary barrier for new users to Hackystat. It should not be too difficult to implement one, especially it was implemented before. Hackystat will gain much free credits from a installer because it will boost the increase in user population and make it less Hackystat-expert only. For users that are not familiar with writing Ant tasks, the installer should also provide a set of templates of Ant build tasks that collect sensor data.

5.2 Performance of Ant Build Tasks

Though there is nothing we can do to improve the performance of the tools used in Ant builds, there is an improvement we can make. That is to reduce the execution times of unit tests to one in verification build. Currently the verification.build.xml, which is commonly used as template for new projects, executes the unit tests twice, one for JUnit sensor data and the other for EMMA sensor data. While the unit tests consume most of the execution time of the verification build, it is a great waste of time. And it is possible to achieve.

5.3 Performance of Analysis

Beside the algorithms to generate the analyses, the REST API is the major cost in processing. It is based on HTTP communication, which is expensive with small piece of data. Thus to reduce the HTTP calls(same as reduce the REST API calls) or , even better, to replace it with direct memory communication in possible environment will be a solution. But we will surely not eliminate the REST API because its the principal contributor to Hackystat's flexibility.

5.4 Data Accuracy

The DevTime is among the most popular metrics. However, it is far from accurate to measure a developer's effort. However, there are too many tools a developer can use to build sensor for each of them. Furthermore, some developing effort is not even made with a computer, such as reading papers. One way to compensate the automatic sensors is to provide a self-report tool for developers to report their effort manually. Though users can cheat on their reports, so can they on a data sensor.

The Coupling is now too sensitive to introduction of new package, thus does not effectively show the structural complexity of the system.

5.5 Data Presentation in SICU

There are many place that data presentation can be improved. They include, but are not restricted to following ideas.

First, for better present Coupling data, it should provide a coloring method that classify values within a smaller range to be good, values within a bigger range to be average, and values out of range to be bad. The trend will be preferred to be stable. Vibrate within average range will be average, and vibrate out of average range will be bad.

Second, not to classify the values of some metrics. Metrics such as complexity and coupling, the preference is know to be lower, but good or bad of a certain is not clear. In this case, the value is better not colored, otherwise it will cause confusion or suspicion of the metric.

Third, SICU can provide an overall health rating of each project, based on their metrics. It will be a fussy rating like five stars, and user will be able to choose correspondent metrics and their weights. It will be more useful when the number of projects become bigger.

References

[1] Philip M. Johnson. Results from the 2003 classroom evaluation of Hackystat-UH. Technical Report CSDL-03-13, Department of Information and Computer Sciences, University of Hawaii, Honolulu, Hawaii 96822, December 2003.

[2] Philip M. Johnson. Results from the 2006 classroom evaluation of Hackystat-UH. Technical Report CSDL-07-02, Department of Information and Computer Sciences, University of Hawaii, Honolulu, Hawaii 96822, December 2006.