

A Detailed Analysis of RSIGuard's DataLogger Functionality



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About Remedy Interactive

Remedy Interactive is the leading provider of software that streamlines ergonomic programs in large organizations, globally. The Company's flagship product, the *Office Ergonomics Suite* (OES), assesses risk, trains employees, optimizes work patterns, and collects data to enable organizations to focus their resources, automate their ergonomics programs, and ultimately reduce costs. The OES's management features are designed to allow companies to do more with less by harnessing the potential of automation.

Remedy Interactive's *Office Ergonomic Suite* is the winner of the 2002 National Ergonomics Conference Attendees' Choice Award for Product Most Likely to Improve Profitability and Productivity.

Remedy Interactive works with Fortune 1000 clients including Hewlett-Packard Company (NYSE: HPQ), ChevronTexaco (NYSE: CVX), and VISA.

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Table of Contents

Introduction.....	4
Establishing the Need for Data Collection	4
What kinds of data does DataLogger collect?	7
A Technical Discussion of the Data Collected	9
Daily Statistics	9
Overall work intensity statistics	17
Keyboard Analysis Tool statistics.....	17
Privacy and Security Issues	19
Options for Accessing DataLogger Data.....	20
Extended DataLogger Tools	20
Future Research Plans.....	23

Introduction

This document discusses in detail the principles behind RSIGuard's DataLogger feature. Other basic documentation on DataLogger can be found separately at <http://www.rsiguard.net/help/helpdlrr.htm>. Detailed analysis of the BreakTimer feature can be found separately at <http://www.rsiguard.com/BreakTimerAnalysis.pdf>.

Establishing the Need for Data Collection

Data about how people work at their computers can be helpful in determining the work patterns that can cause repetitive strain injuries (RSIs) or other computer-related injuries (CRIs). Understanding the causes of RSIs can highlight which solutions are most likely to help an RSI sufferer as well as give guidance in how best to prevent future injuries.

DataLogger collects useful information about how people work at their computers:

1. to help establish baselines before injuries that may indicate causative factors leading to injury
2. to measure the kinds of changes that occur as a result of macro changes in the job environment, and
3. to identify changes resulting from injuries.

Understanding this information about an individual allows an ergonomist to identify the solutions that will provide the individual user the greatest benefit. Understanding this information for an organization allows an environmental health & safety manager to identify the types of problems that most frequently occur, identify individuals who are most likely to have such problems, and to identify systemic and individual solutions to prevent injuries before they occur.

Here are four examples of how RSIGuard data can be used:

1. Determining patterns that lead to high incidence of injuries (using the aggregate reporting functionality of the Health Status Report Viewer) and focusing corrective measures toward healthy individuals who fit the pattern of having a higher risk of future injury.
2. Increasing the effectiveness of ergonomic evaluations by rapidly giving an evaluator insight into how the subject uses the computer both in terms of behavior (e.g. break taking patterns), exposure to repetitive strain (e.g. keypresses, mouseclicks), and exposure to static strains (e.g. time spent using the mouse and keyboard).
3. Providing health-care professionals with objective data upon which to base prescriptive corrections such as work restrictions and job modifications.

4. Increasing the ability of the employer, employee, and insurance company to maintain (or prove) levels of exposure and compliance with workers' compensation-related work restrictions and to provide pre and post injury insight into the actual causes of an injury.

Lets look at an illustrative example.

An employee reports that he is having discomfort in his right arm after a day at work. An ergonomic evaluation, including looking at DataLogger data, shows quickly that he uses the mouse intensely; the evaluator finds that by bringing the mouse closer and using RSiGuard's AutoClick feature, the employee can substantially reduce his pain.

However, because the employee waited a long time to report the injury, these corrections do not completely resolve the symptoms, and the employee visits a physician.

At some point in the employee's care, (e.g. after being designated with a "permanent & stationary" injury) the physician wishes to prescribe a reduction in computer use. The employee provides printed graphs of his computer usage from DataLogger. With RSiGuard's DataLogger, the physician has accurate historical baseline information about the employee's workload. The duration and intensity of both mouse and keyboard use, as well as break-taking patterns – today, last week, last year, etc. – are all accessible. Instead of being dependent on an inaccurate self-assessment, the physician can determine a reasonable reduction based on the actual exposure that led to injury.

The employee uses the Work Restriction feature of RSiGuard so that he and his employer can be confident that he knows how to abide by the work restriction prescription. But, being obsessive, the employee in this example has trouble following the restriction. However, the employer knows about this immediately as opposed to discovering it months later when a stabilized injury might have become more serious.

Recognizing that this employee's exposure levels are above average, and that other employees with similar exposure levels have developed similar injuries, a policy is instituted that employees with such high levels of mouse usage all receive an evaluation of mouse placement, training in AutoClick, and training in keyboard shortcuts/KeyControl.

How much exposure to strain is too much? Are there hard and fast risk thresholds? Historically, there was no way to even know how much strain employees were being exposed to. Because RSiGuard makes that information available, it creates the question of what risks are associated with what levels of strain exposure. Although the research is insufficient to globally define these associations, a company using Health Status Reports will be able to develop a much more meaningful sense of the patterns

that indicate risk. Since RSIGuard is used by various research organizations, we expect that more research will begin to address this critical question with potentially very significantly beneficial results in predicting, and therefore reducing, computer-related injuries.

What kinds of data does DataLogger collect?

DataLogger collects information about how the user is working both in terms of intensity and time. It also collects behavioral information about how the user interacts with the BreakTimer system.

Work-time statistics recorded daily include:

- Date data was recorded.
- Start and end times of computer work.
- Amount of time the keyboard was in use.
- Amount of time the mouse was in use.
- Amount of time that the user was using computer.
- Amount of time that the user rested.

Break-related statistics recorded daily include:

- Number of suggested breaks that were taken.
- Number of suggested breaks that were skipped.
- Total time spent taking BreakTimer-suggested breaks.
- Length of time that the user postponed breaks.
- Number of natural rests the user took of at least 15 seconds, 60 seconds, 4 minutes and 16 minutes.
- BreakTimer usage compliance.
- “Average break length” setting and “average time between breaks” setting.
- Stretch feature usage compliance.
- Number of stretch suggestions the user was given.
- “BreakTimer willpower” setting.
- Work Restriction length setting (or a dynamic value if dynamic restrictions are active).

ForgetMeNot-related statistics recorded daily include:

- ForgetMeNot usage compliance.
- “ForgetMeNot interval” setting.
- Microbreak usage compliance.
- Number of microbreaks taken.
- “Microbreak length” setting.

Keyboard and mouse-related statistics recorded daily include:

- Amount of cumulative strain incurred from using the keyboard.
- Amount of cumulative strain incurred from using the mouse.
- Total number of keystrokes.
- Total number of mouse clicks.
- Average keypress force intensity.
- Total number of times user switched between keyboard & mouse.
- Number of mouse left clicks, middle clicks, and right clicks.

- Distance mouse traveled.
- Number of mouse double clicks.
- Number of manual mouse drag & drops.
- Number of KeyControl assisted drag & drops.
- AutoClick usage compliance.
- Number of AutoClicks.
- KeyControl re-mapping feature usage compliance.
- Number of KeyControl hotkeys used.
- Total number of keyboard errors (i.e. Backspace/Delete usage).
- Number of words the user typed.
- Number of Health Status Reports filed.

Information recorded as a running average includes:

- Average overall keystroke intensity.
- Average overall intensity of keyboard use.
- Average overall intensity of mouse use.

Information recorded as a running average about the keyboard includes:

- How many times each key is used relative to total number of keystrokes.
- A measure of keystroke intensity for each key on the keyboard.
- How long it takes the user to reach each key.

Finally, information provided in a Health Status Report (a subjective self-assessment) includes:

- Name and identification.
- Reason for filing report.
- Current pain level.
- Normal/typical pain level.
- Frequency of symptoms.
- Current medical care.
- Use of anti-inflammatories, wrist-braces, & painkillers.
- Location on body of symptoms (via checkboxes on a front/back image of body).
- Additional symptom and general comment information.

A Technical Discussion of the Data Collected

The descriptions below provide information about each DataLogger-collected statistic. Each statistic has a general description of its purpose (in italics) followed by a technical description that gives a precise descriptions of the manner in which the data is being collected.

Daily Statistics

The following work-time statistics are recorded daily:

Date – *This statistic indicates the date associated with each set of recorded daily statistics.* The date stored is the date of the system clock in the selected time zone selected in Microsoft Windows on the computer on which the executable RSIGuard.exe is executing. RSIGuard stores all daily data to the user's disk drive when: (1) RSIGuard detects a new day has begun; (2) a period of time has passed without caching the information to disk; (3) RSIGuard Reports are requested from RSIGuard; and (4) RSIGuard exits normally.

Keyboard use time – *This statistic indicates how much time a user spends using the keyboard and is a strong indicator of the degree of static exposure to keyboard-related postures.* "Keyboard use" time is calculated by noting the time when a first keystroke occurs, and noting when 20 seconds have passed without a single keystroke. During this time, RSIGuard considers the user to be in the "keyboard-active state". The length of time the user is in the "keyboard-active state" is added to the "keyboard use time" accumulator.

Mouse use time – *This statistic indicates how much time a user spends using the mouse and is a strong indicator of the degree of static exposure to mouse-related postures (considered by many ergonomists to be a key indicator of risk).* "Mouse use" time is calculated by noting the time when mouse activity (moves, clicks or wheel-spins) first occurs, and noting when 20 seconds have passed without any mouse activity. During this time, RSIGuard considers the user to be in the "mouse-active state". The length of time the user is in the "mouse-active state" is added to the "mouse use time" accumulator.

Time using computer – *This statistic indicates how much time a user spends working at the computer and is a strong indicator of the magnitude of static exposure to postures associated computer usage. This is especially relevant if unhealthy postures have been identified for a particular employee. This is not a measure of how long a user is working, because it does not measure time at non-computer tasks.* When the user is in "keyboard-active state", "mouse-active state", or both, the user is in "active state". Time using computer is a measure of how many seconds the user is in "active state". Note that this statistic cannot accurately reflect

extended periods of time where a user is viewing the monitor (e.g., reading text) without using the mouse or keyboard. Note also that the mouse-use time added to the keyboard-use time would not be expected to be equal to the total time using the computer, since frequently the user is engaged in using both the mouse and the keyboard. For example, if the user spent 20 minutes using only the mouse, followed by 30 minutes using only the keyboard, followed by 5 minutes using both, mouse time would be 20+5 or 25 minutes, keyboard time would be 30+5 or 35 minutes, and total computer usage would be 20+30+5 or 55 minutes.

Time user was resting – *This statistic indicates how long a user spends doing non-computer-related tasks at work.* DataLogger notes the first time each day that a user enters “active state”. After that “start of the day” time, when the user is not in “active-state”, the user is in “idle state”. DataLogger notes the time of transitions from “active state” to “idle state” and the time of transitions from “idle state” to “active state”. The difference between these 2 times is added to the “user resting” accumulator, unless the period of rest exceeds a threshold of 6 hours, in which case it is ignored.

Start and end times of work – *These statistics tell the hourly range of computer use during the day which is relevant because work environments can be different at different times of day (e.g. light intensity and source angle, ambient temperature, noise levels).* Start time is the moment RSIGuard first starts up for the day, or, if RSIGuard is left running overnight, the moment the user first uses the keyboard or the mouse. End time is the last time during the day that the user uses the keyboard or mouse. This time range describes how long a person’s workday is. The “number of hours the user uses the computer” statistic divided by the difference between the end and start time tells the percentage of time a user uses the computer.

The following break-related statistics are recorded daily:

Number of suggested breaks that were taken, and Number of suggested breaks that were skipped – *These statistics tell how often a user stopped working for the full duration of a BreakTimer break vs. how often they pressed the Skip Break button.* When BreakTimer suggests a break, the user is given the choice of taking the break, skipping the break, or postponing the break. These 2 statistics report how many times the user took the breaks vs. skipped the breaks.

Total time spent taking BreakTimer-suggested breaks – *This statistic indicates how much time RSIGuard’s BreakTimer has suggested that the employee pause.* Although RSIGuard considers all time without keystrokes or mouse activity over a certain time threshold to be rest, this statistic records only the length of time that the BreakTimer suggests breaks. If this number varies, it indicates that either the user is working more or less, or that they are taking natural breaks more or less. For example, if a user naturally rested for several minutes every 20 minutes, and as a

result, no breaks suggestions from BreakTimer were needed, then this statistic would be zero.

Amount of time user postponed breaks – *This statistic tells how long the user postponed taking BreakTimer-suggested breaks.* Rather than count how many times a break is postponed, this statistic counts how much a break is postponed, making it a more meaningful indicator of the user's behavior. Therefore, if five breaks were taken, and this statistic reported twenty minutes of total postponement time, then on average the user is postponing breaks four minutes ($20 \div 5$) per break suggestion.

Number of natural rests taken – *These statistics tell how often the user naturally takes breaks of the 4 specified lengths.* These statistics tells how often users take breaks on their own without the help of BreakTimer. Four break lengths are recorded: breaks of 15 seconds or more, 60 seconds or more, 4 minutes or more, and 16 minutes or more. For example, a 17-minute break would be counted in all 4 statistics, and a 2-minute break would be counted in the 15 second and 60 second category. This statistic is a strong indication of a person's natural pattern of taking rest and thus may be an indicator of risk, especially if there are users who don't use the BreakTimer.

BreakTimer usage – *This statistic tells whether or not the user is using the BreakTimer.* Used to measure compliance with a requirement to use BreakTimer, this statistic is most relevant when looking at a group of Health Status Reports (e.g. to learn what percentage of some category of users use BreakTimer).

Average break length, and Average time between breaks – *These statistics tell how the user has configured the BreakTimer with respect to break frequency and length.* Note that this statistic does not describe how often breaks actually occurred or how long breaks actually were. It only tells what the user set the BreakTimer to do. Various factors could make the actual values (shown in other DataLogger statistics) higher or lower.

Stretch feature usage – *This statistic tells whether or not the user is using the video stretch demonstrations feature of RSIGuard Stretch Edition.* Used to measure compliance with a requirement to use the stretch feature, this statistic is most relevant when looking at a group of Health Status Reports (e.g. to learn what percentage of some category of users use the stretch animations).

Number of stretch suggestions the user was given – *This statistic tells how many stretches were shown during breaks.* While this statistic tells that the stretches were shown, it does not, of course, necessarily indicate that the user performed the suggested stretches.

BreakTimer willpower setting – *This statistic tells how the user has configured BreakTimer's willpower setting.* Using Health Status Reports, this gives the program

administrator an overall indication of how hard the users feel it is to follow a computer-prescribed break regimen.

The following ForgetMeNot-related statistics are recorded daily:

ForgetMeNot feature usage compliance – *This statistic tells whether or not the user is using the ForgetMeNots feature of RSIGuard.* Used to measure compliance with a requirement to use the ForgetMeNots feature, this statistic is most relevant when looking at a group of Health Status Reports (e.g., to learn what percentage of some category of users use ForgetMeNots).

“ForgetMeNot interval” setting – *This statistic tells at what frequency the user has ForgetMeNots set to appear.* While this statistic tells what the user requested, it isn’t the actual frequency at which ForgetMeNots appeared, which can vary due to a number of factors (e.g., placement of longer breaks, user inactivity).

Microbreak feature usage compliance – *This statistic tells whether or not the user is using the Microbreaks component of the ForgetMeNots feature of RSIGuard.* Used to measure compliance with a requirement to use the microbreaks feature, this statistic is most relevant when looking at a group of Health Status Reports (e.g., to learn what percentage of some category of users use microbreaks).

Number of microbreaks taken – *This statistic tells how many microbreaks were shown as part of ForgetMeNots.* If microbreaks are enabled as part of ForgetMeNots, the ForgetMeNots include short microbreaks. This statistic tells how many microbreaks the user took during the workday as part of those ForgetMeNots.

“Microbreak length” setting – *This statistic tells how long the user has set microbreaks to be.* During microbreaks the user is asked to pause for a period of time (that can be configured). This statistic tells the length of time of microbreaks.

The following keyboard and mouse-related statistics are recorded daily:

Cumulative strain exposure from using keyboard & mouse – *These very important statistics indicate how much the strain the user has been exposed to as a result of their specific keyboard and mouse activities.* A feature unique to RSIGuard’s BreakTimer is that, in addition to monitoring the quantity of mouse and keyboard actions, it also estimates the exposure to strain associated with the actions.

For example, rather than just counting clicks and mouse movement distance, RSIGuard considers the muscular differences required to perform a single vs. a double click, a mouse move vs. a mouse drag, pressing a 'q' vs. pressing an 'h', etc. Each action is assigned a "strain" value, which is a measure of its impact on a user's body based on experiments using baseline electromyography (EMG) tests. Measuring strain is also discussed in the article *A Detailed Analysis of RSIGuard's BreakTimer Feature* located on our website at: <http://www.rsiguard.com/BreakTimerAnalysis.pdf>.

Remedy Interactive believes strain is a stronger indicator of RSI risk than factors like number of keystrokes or mouseclicks. An example of why this is so is demonstrated by comparing "a drag and drop operation" to "clicking on 2 links on a web page." The former exposes a user to significantly more strain, since the drag operation keeps several muscles in tension for an extended period of time, potentially while a bent wrist posture is maintained. However, by counting clicks and movement alone, it would appear to be less activity than the latter activity (e.g., "1 click + mouse movement" for the drag and drop vs. "2 clicks plus mouse movement" for clicking on 2 links). A strain measurement would correctly identify the drag and drop operation as a greater exposure. Thus, measuring strain allows one to differentiate between employees who may spend similar amounts of time on the computer, but whose activities expose them to different levels of strain.

A frequent question is "What values mean high, moderate, or low mouse/keyboard usage?" Based on large numbers of samples of RSIGuard users, the following table shows a rating of mouse and keyboard usage based on strain:

Usage Level	Mouse/Pointing Device	Keyboard
Low Usage	0-600	0-420
Moderate Usage	601-1,300	421-930
Above Average Usage	1,301-2,000	931-1,440
High Usage	2, 001+	1,441+

Another frequent question about this statistic is, "What level of strain implies a risk?" Strain from mouse and keyboard is best analyzed "relatively". In other words, the change in a user's exposure to strain over time, or the level of strain that various users with similar tasks experience has significance.

Future studies may one day correlate absolute values of strain exposure to risk, but at present, Remedy Interactive does not suggest that any particular level is either safe or dangerous. If an organization has 100 employees doing a similar task, there may be a correlation between their strain levels and their RSI risk. Therefore, the return on investment for ergonomic interventions will likely be highest for users with the highest strain values. Strain values between mouse and keyboard cannot be compared since the units of strain for mouse and keyboard have been individually normalized to whole numbers.

How accurately is strain being measured? RSIGuard likely measures strain more accurately than any other method available, with the impractical exception of full-time monitoring of an EMG device attached to a user. But RSIGuard's strain measurements are still only approximations based on the strain measured in wrist muscle groups. Different workstations, as well as different psychological and physical patterns, all affect muscle strain in the wrists, and other parts of the body also experience muscle strains that are less affected by which particular actions are being performed on the keyboard/mouse. Also, although strain is accepted to be a significant factor for RSI risk, there are other factors such as break taking patterns, time at the computer, postural factors, and individual psychological and physiological differences.

Total number of keystrokes/mouse clicks – *This statistic is another indication of how much a user is using the keyboard/mouse.* DataLogger collects the number of keystrokes pressed (without regard to which key is being pressed) and the number of mouse clicks clicked (without regard to which mouse button is being clicked). Double and triple mouse clicks are counted as two and three clicks respectively.

Average keypress force intensity – *This statistic indicates the relative force the user was using to strike keys.* See the Keyboard Analysis Tool description below for more detail about this statistic.

Total number of times user switched between keyboard & mouse – *This statistic indicates how much a user is statically using one input device vs. dynamically switching back and forth from keyboard to mouse.* DataLogger tabulates how often the user switches between the mouse and keyboard. Each switch from using the keyboard to the mouse or from using the mouse to the keyboard counts as one switch.

Number of mouse left clicks, middle clicks, and right clicks – *These statistics tell how many times the user did each of the specified type of mouse click.* This raw data tells how often the user used each type of these mouse clicks. It does not indicate whether these were drag and drops or plain clicks (these are recorded in the mouse strain statistics and in the manual mouse drag & drop statistic).

Distance mouse traveled – *This statistic indicates a relative value that indicates how much the user moves the mouse cursor.* Mouse distance is the distance the cursor moves on the screen and is a reasonable indication of how much the user physically moves the mouse. This statistic is most relevant when used to compare how a user changes over time or how they compare to another user with a similar pointing device. Because of differences in mouse drivers, mouse settings (e.g. acceleration, speed, sensitivity, etc.), and pointing device hardware, there is no way to determine precise distance using a real-world unit like meters. For convenience, the number is presented in reports as a distance in meters. However the conversion is approximate and should primarily be used for relative comparisons of pointer device movement (e.g. a report of 10 meters is twice as much movement as a report

of 5 meters). Note that if you export this statistic, it appears as a number of screen pixels over which the cursor traveled (as opposed to meters).

Number of mouse double clicks – *This statistic tells how many times the user performed a double click.* This raw data indicates how frequent double clicks are for this user.

Number of manual mouse drag & drops – *This statistic tells how often the user performs a drag & drop operation.* This statistic is an important indication of how much exposure a user has to straining mouse activity. One can compare this statistic to the number of mouse clicks to see what percentage of mouse activity is drag & drop (or selection actions). People with high ratios should be exposed to using KeyControl to do mouse-button-free drag & drops.

Number of KeyControl assisted drag & drops – *This statistic tells how often the user performs drag & drops operations using KeyControl.* This statistic is an indication of how well the user is taking advantage of KeyControl to reduce strain associated with drag & drop. If the number is low compared to manual drag & drops, users can receive additional training in using the feature.

AutoClick feature usage compliance – *This statistic tells whether or not the user is using the AutoClick feature of RSIGuard.* Used to measure compliance with a suggestion to use the AutoClick feature, this statistic can be especially relevant when looking at a group of Health Status Reports (e.g., to learn what percentage of some category of users use AutoClick).

Number of AutoClicks – *This statistic tells how many times the user lets AutoClick for them.* This is an excellent indication of how much value a user is getting out of AutoClick as this is roughly proportional to the strain reduction that results from using AutoClick. If a user is using AutoClick but this number is not much higher than the manual left mouse clicks, the user probably needs additional training with AutoClick.

“KeyControl keyboard re-mapping feature enabled” setting – *This statistic tells whether or not the user is using the re-mapping component of the KeyControl feature of RSIGuard.* Used to measure compliance with a suggestion to use the re-mapping feature, this statistic can be especially relevant when looking at a group of Health Status Reports (e.g., to learn what percentage of some category of users use keyboard re-mapping).

Number of KeyControl hotkeys used – *This statistic tells how many times the user has used one of the KeyControl hotkeys.* KeyControl hotkeys can reduce strain associated with the action they are created to replace. Therefore, this statistic is a gross indication of the overall strain reduction the user benefits from by using KeyControl hotkeys.

Total number of keyboard errors – *This statistic indicates how many errors the user is making at the keyboard. DataLogger counts unique groupings of the backspace or the delete key on the keyboard. For example, if a user types: “erfonomic” and presses backspace eight times to change the ‘f’ to a ‘g’, DataLogger counts one error. This is because the user made only one error, even though it required several backspace presses to correct it.*

Words typed/speed – *This statistic indicates how much of the user’s keyboarding is typing of text. Note that it will always be substantially lower than a traditional measurement of typing speed since it includes all keyboard activity. DataLogger collects the number of words typed. The number of words a user types gives an indication of the type of work they are doing (e.g. textual entry vs. keystrokes in database fields). A new word is defined as a series of alpha keys followed by a space or the return key. Text writing produces high “words typed” values. Programming and text editing produce lower values. Keyboard shortcut work, tabbing, use of arrow keys, etc., do not contribute to “words typed” values. Speed is determined by dividing total words typed over total keyboard time. As a result, this is not a traditional “typing speed” measurement, because it includes all the time the user spends at the keyboard, even if they are not typing text.*

Number of Health Status Reports filed – *This statistic tells how many Health Status Reports were filed by the user on a particular day. Normally this statistic is only relevant for looking at a user over a period of weeks or months to estimate, for example, how many reports are filed per month or per year.*

Overall work intensity statistics

The statistics in this section are computed based on computer usage from the moment RSiGuard is installed henceforth. Although the data is recorded daily, the value that is recorded is merely the overall average as it was on the date of recording.

Intensity of keyboard and mouse use – *These statistics indicate over the course of time how intensely the user uses the keyboard and the mouse.* These values are a continuous collection of strain divided by the time over which the strain was accumulated. Although a snapshot of these values is recorded each day, the values are an accumulation over many days. When the values reach a threshold, they are divided in half, thus expiring some of the significance of older data. In this way, RSiGuard can maintain an understanding of a user's changing intensity of use of the keyboard and mouse in a way that filters out the noise of short term fluctuations while still giving higher significance to more recent activity. This statistic (along with others) is used by the BreakTimer to help guide the timing of breaks. Specifically, this statistic ensures that breaks occur, on average, in a more evenly spaced manner.

Average keystroke intensity – *This statistic indicates how hard the user strikes keys on the keyboard.* This statistic takes the keyboard analysis tool's keystroke intensity measurements for individual keys, and computes an average over all keys, to provide a general value for how hard the user is hitting keys. This statistic, however, can only be used as a relative measurement. If a group of users all use the same keyboard, then one can use this value to see who strikes their keys harder than others. If one can observe that a user pounds their keyboard, one can use this statistic to see if attempts to get the user to lighten up (e.g., using ForgetMeNot reminders) are working. See the Keyboard Analysis Tool description for additional details on this statistic.

Keyboard Analysis Tool statistics

The next three statistics are collected by DataLogger's keyboard analysis tool. These statistics are not collected daily, but rather over all time. Approximately once every 6 months, the data is reduced (i.e. the numerator, what is being measured, and the denominator, the number of samples, are both divided by two) so that eventually new data will have more significance than older data.

How many times each key is used relative to total number of keystrokes – *This statistic indicates which keys the user uses most frequently.* This statistic tells, for each key on the keyboard, what percentage of keystrokes this key comprises. For example, a value of 2 for 'A' and 8 for the Tab-Key indicates that 2% of all keystrokes are 'A', and 8% are the Tab-Key, etc.

Keystroke force intensity/How long the user holds each key down on average

– *This statistic implies how much force is applied when the user strikes each key. Since very few keyboards actually measure the pressure/intensity of a keystroke, this statistic measures the length of time a key is held down. A harder keystroke generally corresponds to a longer period of time during which the switch of each key is actuated. This allows one to see which keys the user is tending to hit harder or softer. This statistic is based on a principle that a harder keystroke will engage the key switch longer than a softer keystroke. Although this is not necessarily true for each individual keystroke, we believe it accurately corresponds to pressure over the course of hundreds or thousands of keystrokes. The reported value is in milliseconds (1/1000th of a second).*

How long it takes the user to reach each key on average – *This statistic is being used to experimentally determine dynamic hand position on a keyboard. This statistic measures how long it takes a user to reach each key from whatever previous key they struck. The purpose of this statistic is still being tested, but the hope is that this can be used to help detect hand position on the keyboard as well as detect typing style (hunt & peck vs. touch typing). The reported value is in milliseconds (1/1000ths of a second).*

An important note on the accuracy of recorded data:

DataLogger provides a precise tool for measuring computer use. For typical ergonomic purposes, the accuracy far exceeds what would normally be possible for a human evaluator. This information is provided for researchers who wish to understand the precise limitations of computer-collected usage information.

RSIGuard uses a hook into the Windows event system to count mouse/keyboard activity (also called "input events"). This event system is the same system that notifies each application that it has received input events. For example, when a user presses the 'A' key while in a word processor (e.g., Microsoft Word), the 'A' appears in the document because the event system tells the word processor that the 'A' key was pressed. Therefore, if an application responds to an event, it will be recorded under most circumstances. Even when no application is the target of an input event, the input event still passes through the event system and will normally be recorded.

There are certain circumstances in which the DataLogger would not detect an input event. DataLogger will not record events:

- 1. If the computer is not on.*
- 2. If the computer is on, but RSIGuard is not running (e.g., when the user is booting up, logging in, or if the user exits the RSIGuard program).*
- 3. If the user is using non-standard software that bypasses the normal Windows system for input events. Such a program is unlikely, but theoretically possible. (since v4.0.6 input from MS-DOS applications is recorded).*

Privacy and Security Issues

Employees may perceive DataLogger as an invasion of their privacy because it effectively observes employees and records its observations. You and your employees might also have security concerns. Because Remedy Interactive is sensitive to these concerns, RSIGuard includes several features designed to assist with the management of employee information in a manner that is consistent with the employer's privacy and security policy:

1. DataLogger collects data that describes the manner in which a computer was used, but does not offer any information about what specific work was done. For example, a user playing who inappropriately plays a video game for several hours during the workday would show high strain values and lengthy time-at-work numbers. Although RSIGuard obviously cannot condone improper employee behavior, it is not RSIGuard's role to prevent it.
2. DataLogger stores keystroke frequency information, but stores no information about the order in which keys are pressed. As a result, this information cannot be used to discover what a user has typed. Computer users should understand that any application they use could potentially record keystrokes and store or transmit this information – however, RSIGuard does not do this. All detailed keystroke information is stored in the user's ".kuf" file. This file is always 5,132 bytes, because it doesn't store what a user types. It only contains: how many times each key on the keyboard is pressed; how many milliseconds each key on the keyboard is held on average; and how many milliseconds pass before the release of the previous key and the down-stroke of next key.
3. RSIGuard has basic protections to prevent a user from seeing another user's usage data without a special password. For additional security, Remedy Interactive recommends that customers have processes and controls (normally Windows file protections) in place so that DataLogger data is restricted to a limited number of employees who have a 'need to know', such as health, safety or ergonomics staff members. Customers should also communicate to their employees how the data collected will be used.
4. Health Status Reports are one of the primary ways that an employee's DataLogger data might be revealed to the broader organization. Users have the option when filing a health status report to check the "Exclude DataLogger Data" checkbox. If checked, no DataLogger data is sent with the report.
5. When RSIGuard is uninstalled, RSIGuard leaves the user's configuration in the registry. This information does not contain any usage data. Usage data is not deleted during uninstallation. You can manually delete all data by deleting the user's ".tid" and ".kuf" file.
6. If an employee does not wish to have DataLogger data collected, an RSIGuard administrator can completely disable the collection of DataLogger data from the Admin page of the Settings screen.

Options for Accessing DataLogger Data

The most straightforward way to access DataLogger data is with the RSIGuard companion program, RSIGuard Reports. This program is automatically launched with the current user's data when one selects "View Longterm Usage Statistics" from the "DataLogger Usage Statistics" item under RSIGuard's Tools menu.

This program allows the user to view the graphs in three sizes (small, medium and large). In addition, the graphs can show the data over ranges of time from as short as one week to as long as one year. Finally, the data can be exported by clicking on the "Export Data" menu item in RSIGuard Report's File menu. The data is exported in a comma-separated text format, which can easily be imported into a spreadsheet, database, or other data analysis tool.

Extended DataLogger Tools

The DataLogger system allows a program administrator to collect extensive ergonomic information about a user. This information is beneficial for determining causes of repetitive strain injuries and helping to identify individuals who are at risk of developing injuries. If the administrator's research needs necessitate the collection of higher resolution data, the extended DataLogger tools may be helpful (available only in the English Windows version of RSIGuard). There are two features provided in RSIGuard that extend data collection possibilities.

1. Normally the DataLogger collects information about a user and records that information once per day. The extended DataLogger allows an administrator to record that information at an interval as frequent as once per minute. An administrator can also specify that the data be recorded between two points in time during the day.
2. The keyboard analysis tool of DataLogger collects information about how the keyboard is used, such as how frequently the user strikes each key. The extended DataLogger allows the administrator to specify individual keys and key combinations for which one can collect a precise count of how frequently the key is struck, at an interval of recording as frequent as once per minute.

Unlike the standard DataLogger, the extended DataLogger does not have a graphical user-friendly interface. While it is appropriate for use in the research environment, it is not intended for use by typical end-users or in a typical organization.

Enabling extended data recording

To enable the recording of extended data, one must access the administrative page of the user settings. To do so, while holding of the Ctrl key on your keyboard, click the Tools menu of RSIGuard. Select the first menu item, Administrator's Access. Enter the administrator password, 'adminx'. Next, click on the Setup menu and select the Settings item. Click on the Admin tab and click on the "Data/HSR Settings" button. In the screen that is displayed, enter the start time and the end time during which you want the data to be collected. The time is entered in an unusual format -- number of minutes into day. For example, 1 a.m. would be 60 because 1 a.m. is 60 minutes into the day. Likewise, 8:30 a.m. would be 510 (eight times 60 plus 30). To record data 24 hours a day, you enter a start time a zero and an end time of 1440 (which is 24 times 60). Make sure you press the enable Hi-Res Data Recording checkbox. Data is recorded to the file xxxx-HiResData.txt, in the Data subfolder where RSIGuard was installed. xxxx refers to the Windows username of the currently logged in user.

If you also wish to collect extended data about how frequently a user is using particular key combinations, you will need to create a KeyWatch.txt file. This file must be created in the same folder as the program file RSIGuard.exe. It must contain a list of key combinations that you wish to monitor, one per line, and no more than 64 total key combinations.

The format for defining a key combination is as follows:

CASW###

- C is 1 if the Control key is pressed, or 0 if it is not
- A is 1 if the Alt key is pressed, or 0 if it is not
- S is 1 if the Shift key is pressed, or 0 if it is not
- W is 1 if the Windows key is pressed, or 0 if it is not
- ### is the 3-digit Windows ASCII keycode

Some common keys and their codes follow:

Key	3-Digit Keycode
Backspace	008
Tab Key	009
Enter/Return Key	013
Caps Lock	020
Esc	027
Space	032
Page Up, Page Down	033, 034
End, Home	035, 036
Left, Up, Right, Down arrow	037, 038, 039, 040
Insert, Delete	045, 046
0-9 main keyboard	048-057
A-Z	065-090
Right Click Key	093
Numpad 0-9	096-105
Numpad Multiply, Add, Subtract, Divide	106, 107, 109, 111
F1-F24	112-135
Numlock	144
Scroll Lock	145
Punctuation ; = , -	186, 187, 188, 189
Punctuation. / [\]	190, 191, 219, 220, 221
Open half quote, close half quote	192, 222

Some example entries in the KeyWatch.txt file:

Key combination	7-Digit Entry in KeyWatch.txt File
F1	0000112
Shift F1	0010112
Ctrl Alt Shift Down Arrow	1110040
Spacebar	0000032
Capital A	0010065
Lowercase A	0000065
Ctrl A	1000065
Ctrl Win A	1001065
Windows Key (by itself)	0001000
Ctrl Alt (by itself)	1100000

Key combination use data is recorded to the file xxxx-KeyWatch.txt, in the Data subfolder where RSIGuard was installed. xxxx refers to the Windows username of the currently logged in user.

Future Research Plans

Remedy Interactive understands that RSIGuard represents a powerful research tool. Many of the statistics measured presently are being measured at the suggestion of current researchers in ergonomics, and there are future plans to collect additional data to meet the needs of other researchers as well as the needs of commercial customers. Remedy Interactive will endeavor to provide new statistical features to help further the cause of ergonomic research.

To discuss research opportunities with RSIGuard, or any other aspect of DataLogger statistics, please contact RSIGuard's Project Director, Ron Goodman, at rgoodman@remedyint.com or (415) 332-6433.