



The Truth About Sit-Stand Workstations

WHITEPAPER

Abstract

The scientific data is overwhelming; sedentarism is negatively affecting the health of the workforce. Providing opportunities for workers to move during the course of the workday has become a priority for employers. One of the easiest methods to provide movement while still fostering productivity is the deployment of Sit-Stand workstations. Unfortunately, unless specific strategies are implemented and followed, Sit-Stand units will typically go unused over time, leading employers to question the value of their investment.

This paper discusses the limitations of Sit-Stand units and why over 90% of those deployed are abandoned after 90 days. This paper also outlines specific strategies for proper deployment of Sit-Stand to ensure employee usage and maximum health benefit, and cites the latest research supporting these protocols. A methodology to quantify the effectiveness of the Sit-Stand deployment is presented, with focus on the employee's health, comfort and productivity. Metrics to quantify the Return-on-Investment to the employer of a proper Sit-Stand program are now easily obtainable within the existing workspace and summarized for review.

About the Author

David Bernardi obtained his BS in Mechanical Engineering from the University of Connecticut and his MS in Bioengineering from the University of Utah. After the sale of his medical product start-up company in 2001, David started consulting in the area of office ergonomics, recommending and implementing ergonomic workplace solutions for companies nationwide. As a supplier, David's knowledge of product options is unsurpassed. Based on his successful track record working with insurance companies and at-risk employees, he has become a sought-after resource among insurers who have a vested interest in keeping their clients' employees working comfortably, productively and successfully.

Introduction

Much has been written recently about “Sitting is the New Smoking” or that “Your Office Chair is Killing You.” The data shows that sedentary lifestyles have indeed become the norm, as obesity rates and the incidence of type 2 diabetes are at all-time highs.¹ As a result, movement within the office has become a priority thru various wellness programs, but productivity typically suffers when employees are not at their desks and often programs are not adhered to. In reality, employers spend more treating musculoskeletal disorders (MSDs) than on any other condition or chronic disease, including diabetes, obesity, cardiovascular disease and respiratory illness.² Poor sitting postures due to ill-fitting workstations continues to be a significant risk factor contributing to the development of MSDs in the office environment. As a result, a proliferation of Sit-Stand devices has flooded the marketplace and employers are questioning whether the investment in this type of equipment is worthwhile.

Some manufacturers would have you believe that simply standing instead of sitting is a panacea, but it has been shown that too much standing can be equally as harmful as too much sitting³. In ergonomics, the common advice is “Your Next Posture Is the Best Posture,” emphasizing the need for regular movement. Frequent postural transition from sitting to standing and vice versa is the key to maximizing the health benefit of a Sit-Stand device⁴, by both reducing levels of sedentarism and by minimizing the risk of MSDs. If the goal is to reduce the amount of sitting time by two hours per day, one would be better off physically by standing for fifteen minutes at a time, eight times per day, rather than spending two consecutive hours in a stance mode. Twelve transitions to standing with each bout lasting ten minutes, would be of even greater benefit in this scenario.

Typical Deployment Challenges

Many organizations have tried “Sit-Stand” or “Standing Desk” options and were disappointed when employees didn’t use the devices as intended as enthusiasm to stand waned after a short period of time.

Users who are provided sit-stand options typically describe at least 1 of 4 scenarios to explain their lack of usage.

1. The device wasn’t easy to adjust resulting in a worsening of the symptoms they were trying to alleviate. Many sit-stand devices, in particular units that are placed upon the desk surface and/or non-electric varieties, require substantial amounts of lifting force and/or awkward postures to change the height settings. The resulting stress on the back and/or shoulder muscles can result in strains, soreness or potentially more serious injury such as muscle tears or spinal disc herniation among users with pre-existing conditions⁵.

2. No education was provided on the proper use of the device supplied, resulting in use at incorrect heights for the end-user's stature and thus poor ergonomics. Most employees don't realize that fixed workstation heights (typically positioned at 29.5") are already too high for the majority of workers. According to ergonomic (anthropometric) databases, the average 5'4" female should have her hands placed at 23" when she is seated properly with feet flat on the floor and elbows flexed to 90°⁶. When seated at a traditional worksurface, the user must then elevate their hands at least 6-7" to type or mouse atop the work surface, creating significant tension in the shoulders, upper back and neck muscles as they support this positioning. Thus, sit-stand devices that are placed on top of work surfaces that are already too tall, create a significant challenge for adopting a proper posture for computer-based interaction.
3. Without recommendations for proper sitting & standing durations, many users stand far too long, particularly on the first day of their sit-stand experience. The resulting discomfort (which can last for several days) in their feet & ankles, knees, hips and low back is enough to convince them to not use the device again.
4. Sit-stand devices that are placed on top of the work surface typically provide insufficient space to accommodate the user's workspace needs. When using this type of device in the standing position, the end-user may develop discomfort by frequently accessing workstation tools located on the lower level of their permanent desk. The best case scenario for use of these devices is simply inefficiency and a reduction in productivity. In extreme instances, worker injury due to prolonged neck flexion or frequent reaching can occur.

Best Intentions Gone Awry

In each instance above, the organization allocated funds with the intention of accommodating the employee without the desired result. In many instances, additional funds were then spent to overcome the shortcomings of the original device purchased. For example, a keyboard tray is often purchased to accommodate a sit-stand device that doesn't go low enough. In the case of desktop sit-stand units, a common need is a portable Bluetooth keyboard and mouse to accommodate the different hand height locations of these devices in standing versus sitting. A recent trend is that many workers are now asking for stools or leaning chairs so they can sit at their standing desk! Suddenly the seemingly inexpensive solution becomes a pricy debacle that may not even solve the end-users issue.

Features to Look For

A preferred configuration for a truly functional sit-stand device is one that has at least the following 4 features:

1. The ability to lift a large section of work surface, if not the entire surface, to maximize productivity, workspace and efficiency. This can be accomplished with a number of telescoping leg solutions (sit-stand bases which mount to the underside of the desk) currently on the market.
2. Electric motors in each leg to encourage frequent posture change with little to no exertion by the user. The typical vertical excursion for a sit-stand transition is about 15” and will take about 8-12 seconds with an electric base depending upon the motor quality. Avoid units that use just one motor to drive all the legs.
3. A readout/display showing desk height level for reference and repeatability. These typically offer a programming feature for storing preferred settings.
4. A desk height range that provides proper accommodation for the majority of users, typically defined as the 5th percentile female to the 95th percentile male. BIFMA ergonomics guideline G1-2013 recommends a desk height range of at least 22.5” to 48.7”⁷. This ensures that the majority of staff members will be able to use the desk at proper ergonomic heights in the event of employee turnover or if it’s been deployed in a hot-desking/hoteling environment.

Real Benefits of Sit-Stand When Used Properly

The science supporting the health benefits of reducing sedentarism in the workplace is well documented.^{8,9} Several chronic disease states can be attributed to an inactive lifestyle, including the four most impactful on life expectancy; type 2 diabetes, obesity, cardiovascular disease, and cancer.¹⁰ Let’s take a look at how proper implementation of a sit-stand desk can impact one’s health.

Physiologic Benefits

Better Posture for Better Breathing

When standing upright, humans are able to engage the diaphragm muscle more efficiently for proper breathing technique. Diaphragmatic breathing increases blood oxygen levels substantially by allowing for deeper breaths where oxygen exchange is 5-7X more efficient in the lower aspects of the of the lung¹¹. By comparison, shallower chest breathing engages primarily the upper 1/3 of the lung for less efficient exchange, resulting in less oxygen for the tissues, organs and the brain. This may result in fatigue, increased respiration rates and a higher

pulse rate. Chest breathing also engages the postural muscles of the ribs, upper back and chest. Since these muscles are not intended for active contraction, they can quickly fatigue and when they lack sufficient blood flow, painful trigger points can form and provide chronic irritation.¹²

Post-prandial standing/walking

Standing/movement after meals can reduce blood glucose levels by up to 50%¹³. The simple act of standing for 15-20 minutes after arriving at the office and after lunch can be an effective strategy for reducing blood sugars in high risk employees. Each percentage point decrease in A1c (average blood sugar) reduces the risk of eye, kidney, and nerve diseases by 40%¹⁴.

Muscle Contraction

Contraction of the postural muscles that occurs during transition from sit to stand releases Lipoprotein Lipase (LPL) enzyme which facilitates the breakdown of triglycerides (fats) and increases in HDL cholesterol (ie “the good cholesterol”). LPL levels decrease significantly after just one day of inactivity.¹⁵ Control of cholesterol levels can reduce cardiovascular complications by 20–50%¹⁶. The health benefit of frequent sit to stand transition has been well documented by Vernikos¹⁷. Additionally, contraction of the lower extremity muscles stimulated by active standing helps to activate the venous pump system and increases blood flow wave action to the brain¹⁸.

Active Standing

Non-Exercise Activity-based Thermogenesis, aka NEAT, a concept described by Levine et al¹⁹. On average, active standing burns 0.7-0.8 calories extra per minute²⁰. It has been shown that non-obese individuals have higher levels of NEAT in their lives²¹. Incorporating just 30 min of activity into the workday can reduce the risk of developing various disease states including cardiovascular disease and type-2 diabetes.

Relax Hip Flexor Tightness

The Hip Flexor complex, composed of the psoas major and the iliacus, is the only muscle group which ties the lower extremities to the torso and upper extremity. When seated, the muscle is in a shortened position. Excessive sitting leads to a chronically shortened muscle which can alter spine mechanics by rotating the pelvis, but may, more importantly impact stress levels in the body. The Hip Flexor is a “Fight or Flight” muscle group, with a direct tie to the amygdala of the brain. This feedback loop results in increased release of the stress hormone cortisol²³. Excessive stress levels can affect an individual’s mental health, which is now becoming a huge financial burden to business²⁴. The presence of cortisol has also been shown to inhibit insulin function in the body²⁵, the substance necessary for processing sugars in the bloodstream, thereby leading to excess fat storage and quite possibly diabetes.

Ergonomic Benefits

Proper Hand Positioning for Sitting & Standing

The ability to lower the worksurface to proper hand position is key for relaxing the trapezius, upper back, shoulder and neck musculature. As stated earlier, seated work at a worksurface that is too tall requires a constant contraction of these muscles to support the hands in an elevated position. Chronic muscle tension can lead to a host of musculoskeletal disorders including trigger points, thoracic outlet syndrome, headaches and/or migraines and numbness & tingling in the arms.

Increased Blood Flow

Since standard desks are too tall for the majority of the population, many workers at fixed height desks have to raise their chair to a height in which their feet are no longer on the floor. Even with a footrest, there is an increased tendency to sway the feet back and rest them on the chair base. Alternatively, one may lean forward in their chair to get one's hands high enough to type and mouse, leading to a forward hunch with closed angles (less than 90°) at the waist and elbows. Using the analogy of a garden hose, picture how the water stops flowing when you kink it. This positioning of the body will provide greater vascular resistance which means the heart must work harder to circulate blood, thereby increasing blood pressure. A properly deployed sit-stand desk with proper height range eliminates these issues.

Reduced Disc Compression

Standing upright significantly reduces compressive forces in the spinal discs. For comparison sake, compressive forces when sitting in the traditional 90-90-90 "ergonomic" position are about 40% higher than standing.²⁶ When seated in the forward hunch position described above, the forces are about 70% higher than standing.²⁷ For individuals with Low Back Pain (LBP), which is reportedly 11% of the population,²⁸ providing proper ergonomics including Sit-Stand capability with the ability to change posture, resulted in a significant reduction in pain levels.²⁹

Effects of Sit-Stand on Productivity

There have been many papers and studies claiming productivity increases as a result of sit-stand desk implementation. Garrett and colleagues³⁰ recently reported a 46% increase in productivity within a call center environment. 25 research studies reviewed by members of the Puget Sound HFES showed a mean increase in productivity of 12% with the highest study reporting 64%³¹. Callaghan et al reviewed 8 studies of sit-stand usage and concluded three showed good evidence of significant productivity increase, 4 did not show significance, and 1 was inconclusive with the overall conclusion was that sit-stand does not adversely affect productivity.³²

The Challenge and a Solution

When the deployment challenges outlined at the beginning of this paper are coupled with the quantity and inconsistency of the productivity reports, employers are being faced with a significant dilemma in the evaluation of the benefits of adding sit-stand work stations within their work environment. Facility managers, HR professionals, and EHS teams may find themselves having to answer the following questions for the C-Suite:

Does the productivity findings of the available studies correlate to our specific work environment and worker population ?

What impact will sit-stand truly have on the health and wellness of our team members ?

What impact will investing in sit-stand have on our overall bottom line ?

There are now commercially-available tools that enable organizations to answer these questions within their specific work environment. The LifeDesk® along with its companion SmartLegs™ App by Right Height Manufacturing is one such product.³³ The advantages observed include:

- The ability to test a small sample (minimum of 10) at minimum costs (a test before you invest concept)
- Being "furniture agnostic" - the telescoping legs of the LifeDesk were able to be placed under existing furniture workstations from any manufacturer and in most all configurations.
- Ease of use - The software itself is user friendly and other than downloading the app to the users' mobile device, no additional installation was required.
- Enterprise Level Reporting - Qualitative and quantitative data is collected at the user level and aggregated for enterprise level reporting.

Benefits of a “Smart” Sensor-based Solution

Integration & Education

By leveraging their Smartphone, LifeDesk users are able to easily determine ideal sit and stand heights for their unique body type, and receive reminders when it's time to transition their desk. Research has shown that software reminders leads to an increase in proper desk usage and more frequent postural transition.^{34,35} Transition intervals and their corresponding reminders are available in a myriad of options, depending upon the goals, job tasks, fitness level and other motivations of the user.

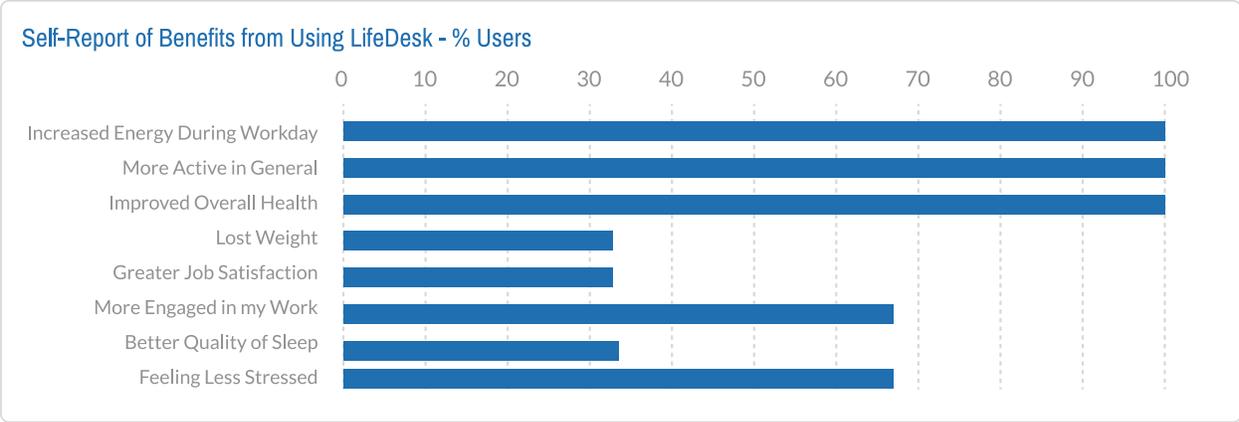
Quantifying Health & Productivity Benefit

Prior to the first use of the LifeDesk SmartLegs App, the user is given a survey to establish baseline levels of workplace comfort and productivity. After a designated amount of desk usage, the survey is re-administered to quantify the physical and mental benefits the desk has had on the user. Individual and group metrics are automatically quantified, collated and summarized in graphical format.

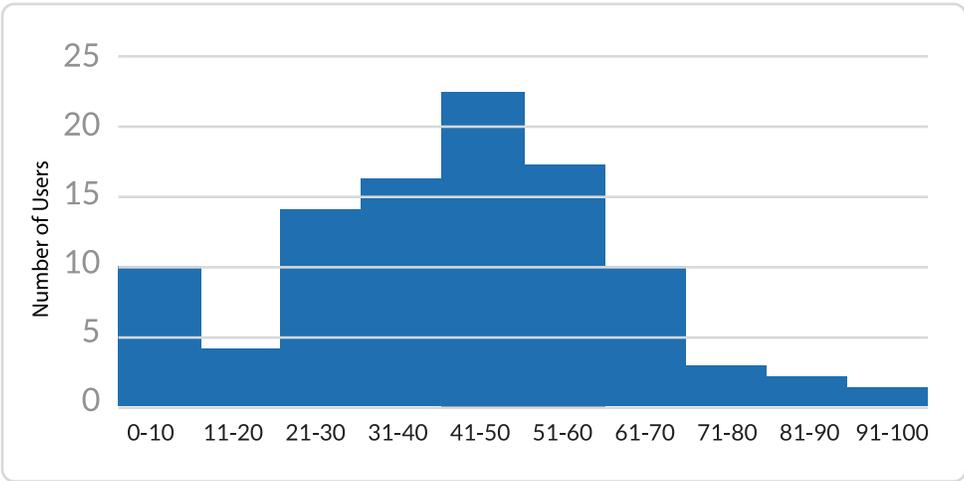
In the below study of employees at a regional bank, the following data was collected.



In the baseline survey results, users reported an average discomfort of 7 in their workspace on a scale of 0 to 10, with “0” being “No Discomfort” and “10” being the “Worst Pain Imaginable”. After 90 days of using their Sit-Stand, average discomfort was reported as a 2, marking a 71% reduction in overall discomfort. Users also reported an average sitting percent of just over 95% and the need of 7 breaks per 8 hour workday due to discomfort. After 90 days of desk usage in their workplace, actual sitting times were quantified at about 55% and reported breaks dropped to an average of 2.7 per day. When asked to quantify the impact the user felt the desk had on their overall productivity on a scale of -25 (25% reduction in productivity) to +25 (25% increase), the users reported an increase of just under 20%.



In the post-usage survey, users have 15 criteria they can select as possible benefits or negative effects they experienced as a result of using the sit-stand. The most selected criteria are displayed in the graph above with 100% of the users reporting a feeling of increased energy, improved overall health, and that they were now more active overall. Almost 2/3 of the users reported feelings of being “More Engaged” as well as “Feeling Less Stressed”.



Group metrics of overall usage of the desks can be quantified via histograms similar to the above reflecting the “Average Daily Percent of Standing Time” as well as the “Average Number of Daily Transitions per Desk”.

Return on Investment (ROI)

A productivity-based ROI calculator is available online thru Global Workplace Analytics³⁶. Key variables for the ROI calculator include desk utilization rate and projected productivity increase. Variables specific to the customer can be factored such as average salary & benefits for the staff

using the desks, quantity of desks to be implemented, and the revenue to salary ratio. Acquisition and implementation cost of the desks can also be input to reflect the type of desk and the negotiated pricing. The **Self-Report of Perceived Change in Productivity** based on the survey data obtained with the SmartLegs™ App can be used as an input or if actual throughput data is available depending on the nature of the work, that would be most appropriate.

Conservatively, a tangible productivity increase is more likely to be in the 3% range which simply translates to an extra 15 minutes of productive work per day. This is easily attainable simply by eliminating the need to take a break due to physical discomfort. This goal is substantiated by the reduction in **Daily Breaks due to Discomfort** reported by the SmartLegs™ App survey data.

According to this web-based calculator a modest 3% increase in productivity amongst 50% of the sit-stand user population results in about a 7 month payback assuming an average staff wage of \$50K per year.

Value on Investment Model (VOI)

A proprietary VOI model and calculator was constructed in an attempt to quantify the financial impact that a successful sit-stand deployment could make on the six largest workplace financial drains facing corporate America; Absenteeism, Presenteeism, Employee Turnover, Musculoskeletal Disorders (MSDs), Obesity & Diabetes and Mental Health.

Absenteeism — The average worker takes a little more than 5 days of unscheduled absence per year according to a recent survey³⁷. Absenteeism rates increase 2x for individuals with one chronic disease and up to 5x for workers with 2 or more chronic diseases.³⁸ At an average pay of \$50K per year, 5 absences translates to about \$1000 in paid wage without the corresponding output. The financial impact of absence in an organization is far greater, but for simplicity the calculator uses an approach based solely on wage. By impacting absenteeism thru healthier lifestyle and increased overall health, absence rates should reduce over time and the financial aspect of such will be reflected in this segment of the calculator.

Presenteeism — Lack of engagement of the workforce affects about 70% of the workforce³⁹. There is about an 18% decrease in productivity amongst disengaged employees⁴⁰. Gallup estimates that actively disengaged employees cost the U.S. \$483 billion to \$605 billion each year in lost productivity.⁴¹ Results of the **LifeDesk Benefit Survey** have shown that LifeDesk users using the SmartLegs app have higher levels of engagement and this effect can impact the bottom line.

Employee Turnover — According to a recent report from the Work Institute, turnover rates for 2018 were about 1 in 4, costing business about \$600B in turnover costs.⁴² Costs of replacing employees averages 33% of their salary, or about \$15K using the median US wage of \$45,000.⁴³ Increasing job satisfaction with a Sit-Stand (documented thru the **LifeDesk Benefit Survey**) may help reduce turnover rates within the organization. It has been shown that office environment is a large contributing factor in employee retention and talent acquisition.

Musculoskeletal Disorders – MSD affects 54% of the working adult population and annually costs \$874B in treatment and lost wages.⁴⁴ These conditions are exacerbated by poor work postures and overuse and will continue to get worse as the aging workforce puts off retirement and a largely deconditioned younger generation of workers are added to the workforce. Improving employee comfort, such as encouraging frequent postural changes, proper Sit-Stand deployment decreases the likelihood of developing or worsening MSD in the workplace. The **LifeDesk Smartlegs App Discomfort Survey** results are used to quantify this impact.

Obesity & Diabetes — As stated earlier, obesity and type 2 diabetes rates are at all time highs, in the US due to increased sedentarism, poor nutrition and increasing levels of stress. About 7% of the workforce has been diagnosed as diabetic, and 1 in 3 workers are pre-diabetic⁴⁵. These 2 categories are lumped together as 90% of type 2 diabetics are considered obese. The direct costs to business such as healthcare & supplies are \$237B and indirect costs such as lack of productivity are about \$90B⁴⁶. A survey of LifeDesk users report higher levels of activity outside work, and some report losing weight. Increasing activity levels, even by 30 minutes per day, reduces risk of developing diabetes and cardiovascular disease⁴⁷.

Mental Health — Mental Health disorders affect about 1 of every 5 employees⁴⁸, and less than 50% seek out help for their issues, resulting in significant levels of presenteeism. Major depression alone costs US businesses about \$210B per year⁴⁹ with half of that amount attributed to loss of productivity. A percentage of Sit-Stand users report being “Less Stressed” in the **LifeDesk Benefits Survey** thereby quantifying some level of impact.

Summary

Scientific research supports the purported health benefits of Sit-Stand workstations provided they are implemented and used properly in the workplace. A new monitoring system with a desk sensor and app (Smartphone or Web-based) can ensure proper height settings for the user as well periodic reminders to transition. Self-reports of health and productivity impact for the end-user, as well as usage metrics can provide the employer with the necessary data to drive business decisions regarding desk deployment strategies throughout the enterprise. The data also allows the enterprise to assess the financial impact of the desk deployment in terms of productivity ROI. Additionally, the VOI impact in the areas of employee disease management for MSD, Mental Health and Obesity as well as elements of employee engagement such as Absenteeism, Presenteeism and Turnover.

For more information on the product used in the study presented in the whitepaper, contact the support team at LifeDesk via email at customerservice@thelifedesk.com.

Footnotes

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