SUSTAINING HUMAN ENERGY

by

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A theory submitted in furthering our understanding of continuing human evolution

Inventors

HUMAN BALANCE AND STABILITY SYSTEMS

HBS Systems

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ABSTRACT

Sustaining Human Energy™

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The present document describes the effects of standing for extended periods of time, beginning with evolution of man and covering the resulting symptoms of body pain, fatigue and the detrimental health aspects while identifying the causes and ultimately, providing a solution resulting in the improved health, safety and productivity on the human body via the Human Balance and Stability System.

The highlight of the developed system is that by providing a contact point for the shins, the individual experiences reduction and control of body sway which relaxes the fascia layer and muscles used to balance. As this occurs, the cognitive thinking focused on balance, stability and relief of the associated fatigue and body pain resulting from standing is reduced and more cognitive thinking is placed on the task being performed. The results are improved posture, health, safety, productivity and even improvement in the mood of the individual.

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ACKNOWLEDGMENTS

The authors wish to express sincere appreciation to the entire human race for their assistance in the preparation of this manuscript. We recognize their experiences in survival, evolution, rearing offspring, performing stationary standing tasks, developing chronic health issues throughout their lives and ultimately suffering as they further endure the debilitating process of old age. In addition, special thanks to those standing mechanics who's solutions, improved working conditions. Whether those conditions were safety, health or productivity; it is the in the spirit of their ingenuity that we were able to recognize the problem and engineer a solution that will have a positive impact on humanity for evermore. We thank you.

"To leave the world a bit better, whether by a healthy child, a garden patch, or a redeemed social condition; to know that even one life has breathed easier because you have lived - that is to have succeeded". Ralph Waldo Emerson

GLOSSARY

Balance: An even distribution of weight enabling someone or something to remain upright and steady.

Bipedal: (Of an animal) using only two legs for walking.

Cognitive thinking: Refers to the use of mental activities and skills to perform tasks such as learning, reasoning, understanding, remembering, paying attention, and more.

Equilibrium: Physical, chemical, or social science equilibria, and wider contexts, the conditions of systems in which all competing influences are balanced.

Fascia: a band or sheet of connective tissue, primarily collagen, beneath the skin that attaches, stabilizes, encloses, and separates muscles and other internal organs.

Ligament: The fibrous connective tissue that connects bones to other bones and is also known as articular ligament, articular larua,[1] fibrous ligament, or true ligament

Metatarsal: A group of five long bones in the foot, located between the tarsal bones of the hind- and mid-foot and the phalanges of the toes.

Persistence hunting: Is a hunting technique in which hunters, who may be slower than their prey over short distances, use a combination of running, walking, and tracking to pursue prey until it is exhausted.

Postural: Pertaining to the posture or position of the body, the attitude or carriage of the body as a whole, or the position of the limbs (the arms and legs).

Posture: A position of a person's body when standing or sitting.

Prehensile: (Chiefly of an animal's limb or tail) capable of grasping

Sway: The horizontal movement of the center of gravity even when a person is standing still.

Tendon: a tough band of fibrous connective tissue that usually connects muscle to bone and is capable of withstanding tension.

Thoracic Cavity: The chamber of the body of vertebrates that is protected by the thoracic wall (rib cage and associated skin, muscle, and fascia).

PREFACE

The following document is based on uncontrolled testing, design and development of technology to benefit people who stand to perform tasks. Our findings do not reflect in whole or in part the intent of any one reference made in this document but ventures to utilize each reference to explain our theory as a whole. Small inventors such as HBS Systems, often lack the capitol required to perform extensive research and must rely on published research to form our conclusions. Never the less, extensive time has been expended on that research to form this conclusion and further research is underway to continue the evolution of standing. The definition of a theory is "a supposition or a system of ideas intended to explain something, especially one based on general principles independent of the thing to be explained". A thesis is "a statement or theory that is put forward as a premise to be maintained or proved".

INTRODUCTION

Precision grinding service support manufacturing companies in attaining the final tolerances required on tooling, gages, fixtures and parts often holding tolerances of .0001" and even .00005". This tedious and specialized process follows automated CNC machining and involves the use of manually operated grinding machines. These machines require the operator to stand in a specific location allowing the individual to comfortably and safely reach handles and switches while at the same time allowing loading, unloading, adjustment and checking functions as the job progresses. These jobs consist of pieces in quantities ranging anywhere from (1-500) pieces and although the time spent in this specific location varies, consecutive orders insure that the individual will remain in this position from (8-12) hours a day. Many machinist who have been doing this work for over thirty years have developed chronic pain in our feet, ankles, legs, back and neck.

One of the most notable conditions standing machinists experience is "clenching" of the toes as they navigate towards and reach into or over these machines. When we consider that precision grinding machinists hold tolerances of 1/30 of a human hair, we see the additional stress that is added to the difficulties of these movements. When reaching into the machine they feel their toes clenching as if they are trying to grip the floor. After years, the condition becomes debilitating and often prevented workers from performing the more important tasks of playing with their children, doing household chores and even cooking meals at the end of the day. This condition is noticeable in infants who are learning to take their first steps. As the child initially stands upright, you notice the toes are clenched. But remarkably, as they find their balance and begin gaining bipedal mobility, the toes relax and they are off and running. This is where our research begins.

Chapter 1

EVOLUTION

Human beings continue to research ways to benefit humanity from the smallest particles to the origin of the cosmos. We look for solutions to health, productivity and even happiness to insure the human race continues. For a moment, let us theorize that we need look no further than the evolution of man to identify our biggest nemesis. The human body has obviously evolved to bipedal travel as we are able to efficiently transfer our body weight in a forward motion with only our feet to support us. The New York Times published an article titled "The Human Body Is Built For Distance" which provides insight as to why early humans evolved to be runners. We have evolved from a body covered in hair to more closely resemble humans today, who have very little hair on the body. The early humans practiced persistent hunting to outlast their prey. The lack of body hair enabled the cooling of the body through sweating while the mammals they hunted relied in panting to cool their hair covered bodies from exhaustion. The cooling aspect while developing the ability to run provided humans with the ability to outlast our prey. This development resulted in shorter toes than longer toed animals, alignment of our large toe with the other toes, and even a narrow waste to utilize our arms which all resulted in a higher degree of balance. Primate foot structure, [like humans] have five toes. The foot has a soul, a heel, a ball and five metatarsals. However human feet have evolved away from the common primate foot anatomy to better allow bipedal walking. The arch of the chimp foot, therefore, is shallower than that of a human foot. Prehensile feet are lower limbs that possess prehensility, the ability to grasp like a hand. They are most commonly observed in monkeys and apes, who similarly possess prehensile tails and this difference allows for efficient climbing, swinging and accelerated ground

travel with balance and agility. Humans evolved with ligaments and tendons which are much more suitable for running. Unfortunately for those of us who stand all day, the mammals our ancestors hunted did not stand in one place for extended periods as we hunted them. Had they done so, we may have continued our evolution to develop more suitable means for balance and stability in that position.

It would appear as though the human body has not yet evolve to bipedal standing yet most of us do it every day for most of the day. Due to the development of bipedalism in humans, the hands became the focus of prehensility and the feet adjusted to more of a stabilizing role. It may be possible, however, that the foot does not reach its limits of dexterity due to the constant muscle tension needed in stabilizing and balancing the foot to hold up the legs and the rest of the frame. Through movement of the feet in upright travel, we experience at least some movement of these ligaments and tendons which provides a reduction in the tension associated with stabilizing and balancing in any *one* foot position. PBS recently aired a series called Your Inner Fish: "Episode 3: Your Inner Monkey" which provided specific explanations as to why standing has been so difficult for humans. Our early ancestor primates lived in trees foraging fruits and vegetation as well as escaping predators. It is not surprising that these primates developed incredible balance and stability in their movements. What is surprising is how they evolved to achieve them. Chimpanzees are capable of walking on their two legs, but they are only partially bipedal, as they typically tilt their body weight forward and use their long arms for balance. Humans evolve to stand upright which resulted in an "S" shaped spine to counter the weight of our thoracic cavity in an upright position. This causes serious issues for the human spine which results in compression of the vertebrae and in many cases, fractures due to prolonged improper posture and resulting weight balance.

One can theorize that when we consider the function of standing for extended periods of time as opposed to the forward movement, the tension needed to stabilize and balance the foot to hold up the legs and the rest of the frame, becomes much more acute and actually spreads throughout the fascia of the body. It has long been known that the fascia must remain flexible and relaxed to retain its elasticity to hold balance in conjunction with the muscles they surround. When standing for prolonged periods, individuals consciously and or subconsciously begin to shift from one foot to the other and lean or search for some other means of assistance for the relief of this tension. It should be noted that in shifting from one foot to the other the body simply shifts nearly its entire weight from one foot to the other, further complicating the efforts to relive the tension. Leaning moves the center of gravity from a "centered" location supported by the feet to an "off center" location supported by the feet. Based on this theory, we can surmise that the condition reflects an increase in the lack of balance and stability in a standing position.

Chapter 2

SYMPTOMS

As discussed in the previous chapter, mankind has obviously evolved to bipedal walking but standing for prolonged periods of time is something new to us, relatively speaking. One can theorize that humans developed this trait through our process of industrialization. As humans began to produce goods, we began to stand to perform these tasks and it is not until the need to mass produce goods, that we begin to see standing in one location for prolonged periods become so prominent. The symptoms of pain discomfort and fatigue we experience today have a relatively short history. One of the most ingenious inventions has been the chair. The Chinese are believed to have first utilized chairs though be it mostly to climb up and onto horses. At the time, the chair seemed to provide the most sought after solution to these symptoms of standing, so much so that it was later mass produced [by even more people standing to do so].

Today we have chairs everywhere; on mass transit systems, bus stops, waiting rooms, offices, and literally anywhere people are. It does sound fairly obvious to us but consider that we spend so much time in chairs now that researchers are discovering that we are actually harming our health. The health benefits we see from walking and running can be offset by sitting when we are not mobile. Inventors as well as employers are recognizing this and have set out to change it. In recent years the focus has shifted from sitting at work to standing and providing apparatuses to assist standing such as stand up desks, sit-stand work stations and even devices such as copper lined socks, braces and sole inserts have flooded the market. Science Direct published an article titled "A systematic review of standing" in which researches report that workplace

standing is beneficial to heart rate, cardio metabolic factors such as HDL cholesterol and even the mood of the individual. One could contend that the devices on the market today only treat the symptoms of standing for prolonged periods of time. Symptoms include conditions such as foot pain, fallen arches, ankle pain, leg pain, lower back pain, upper vertebrae pain, vertebrae degradation, neck and shoulder pain, poor circulation, and even poor posture. Although products manufactured to date may very well improve a person's threshold to these symptoms, they do not appear to be a solution to a cause. These symptoms would appear to begin as we reach adulthood and venture into the workplace. As we become adults, time and responsibility no longer allow for simply sitting down in the cool grass to combat our fatigue and pain. As we further our careers in which standing is required to perform our tasks, we develop chronic ailments related to these symptoms and begin addressing them by sitting down on a stool in our work stations, wearing braces to support our posture, taking unscheduled breaks, pharmaceuticals and so on.

As we continue our lives and ultimately reach the end of our careers, we not only have chronic health issues developed from extensive stand in place conditions, but we also fight the process of aging. Our body's simply cannot repair and rejuvenate as they once did. Biodex published an article titled "Recovering balance: Classes help seniors prevent falls" in which the loss of balance as we age is largely preventable. In 1995, the late Dr. David A. Winter PhD [considered by many to be the father of Biomechanics] published an article titled "Human Balance and Posture Control During Standing and Walking" citing that in 1991 (Canada) there were more elderly (70+) deaths attributed to falls than were attributed to automobile accidents in those aged 15-29. So, we can safely assume

that as the current generation continues to experience the growing demands of an automated workplace, they remain in the workforce longer, and their health issues result in more health care, the need to address standing has become imperative.

Today we see a radical change in thinking regarding the workplace and as stated previously, standing is proving to be heathier than sitting. Published and ongoing research such as an article in The Seattle Times "Stand-up-desk trend also carries health risk" suggests that although standing is beneficial to health, such activity should be limited to only part of the time and that movement (including bipedal walking) must accompany the effort. Behavior Fit published an article titled "Please Leave Your Office: The Danger of a Standing Desk" in which the excessive duration of standing is addressed and points out that it is important to move periodically regardless of sitting at work or using a standing desk.

In essence, we are seeing designs entering the market by people who sit at desks that will allow people who sit at desks, to stand. That seems to leave an extreme wealth of knowledge out of the equation; people who stand to perform tasks all day. We believe that the reason for this is simple. People who stand to perform tasks generally have little time, accessibility to technology or even capitol to allow for personal research to solve this problem let alone identify the cause and engineer a solution. We might have time to find a stool for our work station, build a more accessible shelf to assist our reach or simply perform the task a little slower to avoid complete fatigue and exhaustion but the large population of people who really need a solution, cannot take the time to find one. Hazards Magazine published an article titled "Humans are not made just to stand and work" and poignantly addresses ailments, at risk jobs, little used regulation for standing workers, reluctance of employers to engage in the issue, health issues

from standing and even the reluctance of the occupational health and safety authorities to take this issue seriously. In fact, the Canadian Centre for Occupational Health and Safety has an article posted on their website titled "Foot Comfort and Safety at Work" which identifies some causes of foot problems due to standing and advises on the need to consider what type of shoes are appropriate for they specific type of floor .Very little useful corrections are mentioned and simply states that we should relax our calf muscles, and straighten ankles and knees. Perhaps the most impressive description of these conditions was presented as a TED Talk titled "Sitting Kills, support Standing" in which we find indisputable arguments of how vast the problem of standing is and how critical it is to find a solution.

Individuals who perform standing tasks all day are simply trying to get though the day as productively as they can. We are fortunate in that we own our own business, have accessibility to technology during the day and though be it limited, have some expendable capitol to address our personal research. Between those factors and over thirty years of experience with chronic symptoms of standing we have put the practice of ingenuity to this problem to fix our machine, our own bodies.

Chapter 3

CAUSES

To understand the cause of pain, discomfort and fatigue while standing, one need only look at the activities they perform while standing. The machines we operate are engineered to keep us in one stationary, safe, and comfortably reachable position throughout the entire process of performing our tasks. In fact, we place adjacent tables directly opposite our machines [or behind us] for minimal changes to our position as we access objects required for our task. For instance, the parts we are machining must be accessible to allow for loading and unloading from the machine safely and effectively. The tools we need to measure the tolerances, interchange our parts or make adjustments to the tooling must be as close as possible to increase productivity. So, the option of bipedal movement recommended to offset standing is not an option. This condition leads to hours and hours of standing in one place for days, weeks, months and years on end.

We have all heard the old adage that to prevent back injury, we are supposed to lift with the knees and use our legs [rather than our backs] to leverage the weight. This is because we must adjust our center of gravity to balance as we perform this task to prevent injury. Lumen Physics provides a valuable tutorial titled "Stability" to explain the relationship of equilibrium, balance and the center of gravity. Even more appropriately, a source for understanding these conditions was published by Slide Share titled "Physiology of Equilibrium & Balance". The body is constantly tensing various muscles to balance while standing and control body sway. Biomechanical research continues to advance valuable knowledge on these conditions and effects. The Journal of Neurophysiology published an article on Postural Sway which describes that placing one finger on a surface has a stabilizing effect on sway. We implemented those same tests [though be it

uncontrolled] and found an instant calming of the tension in the fascia and muscles used to balance. So we can surmise that our balance and stability directly impacts sway and controlling sway can have a positive impact on the symptoms of prolonged standing. From biomechanical research, one can theorize that when performing auxiliary tasks is added to the complex activity of standing in place, these same muscles are even more taxed and we depend on even more muscles to perform the specific movements of the task. The conclusion is that we are expending valuable energy on balance and stability which can lead to fatigue and pain while our posture degrades.

Chapter 4

FOCUS

All of us attempt and perform complicated tasks on our feet and often times, these tasks require more than our hands and feet to accomplish them. We perform these tasks so effectively yet lack the simple knowledge to allow our personal machine, the body, to endure it. Our research led us to the article published by The Emotion Machine titled "Expanded Awareness And The "Car Body" Phenomenon" in which the similarities are described between the brains ability to treat the automobile as an extension of the brain and the brains ability to do the same with our body. In essence we can control our movements and effects from those movements on our bodies through awareness and cognitive thinking. Similarly, Discover Magazine published "Brain treats tools as temporary body parts" in which we learn that the tool itself becomes an extension of our arms. This understanding of cognitive thinking is critical in defining what we are actually doing when we are standing and performing tasks.

Any given task requires a multitude of decisions, preemptive thinking and learning we summarize as cognitive thinking. As we load parts into our machines, adjust the tooling controls, check the speed, bring the cutter into contact while insuring safety proximity and balance we are performing cognitive thinking. The same is true for most every standing job from cashiers to surgeons and if we experience body fatigue and pain, we at least expend part of our cognitive thinking on that as well. Take for instance the new generation of "Gamers" as shown in the YouTube post titled "Oculus SEXY Rift: The Best and Funniest OR Reactions Ever" in which we see the cognitive thinking being performed by gamers and the resulting reactions. Also of particular interest to us was the loss of balance and

stability experienced as they engage in this technology. One can theorize that if we can balance and stabilize our bodies to reduce the cognitive thinking required to address the fatigue and pain so more of our attention can be focused on working healthier, safer and more productively.

Chapter 5

FIXING THE MACHINE

Humans continue to develop more complicated and efficient machinery to improve production whether for manufacturing, medical technology, assembly or countless other sectors and purposes yet we continue to ignore the people who operate those machines. Of course one could argue that automation is advancing to eliminate the person who stands at the machine but the reality is that it will be many decades before humans are no longer needed to stand on their feet to perform tasks.

Mechanical aptitude is a unique trait in the sense that those of us who have it, seem to have a predisposition to fixing things. Most mechanics can remember the tools they received as gifts much more readily than the toys they received. Our minds seem to work differently in that respect and it seems to drive us to not only think about how the tool is used but how the tool *can* be used. In manufacturing, especially in tool and die work, machinists determine ways of holding parts, organizing the tasks and even repairing machines to be as accurate and productive as we can. Our ability to successfully perform these processes makes us craftsmen. Repairing a machine begins with determining what the issue is, locating the manual, engineering a solution, installing new parts, and reassembling the machine. When we look at our body as a machine, we can employ the same approach. By determining that our feet, ankles, legs, back and neck feel fatigue and pain, simply consult the human manual beginning with evolution and engineer a solution to rebuild the body.

The initial days leading to this solution were sobering to say the least. As the business grew and volumes rose, it became quite concerning that we

would not be able to physically meet those demands. We had put a great deal of time and effort into our business and had abandoned one career to focus on the other, together. Each day we changed shoes multiple times and each night the pain seemed to become worse, due in large part we suppose, to knowing we had to do it all again in the morning. One afternoon in late August 2015, with temperatures reaching 100 degrees in our shop, Cathy decided she had changed her shoes enough. She simply had to find a way to relax her feet or we would have to look to other means to make a living. As I continued to work, Cathy began working on a support.

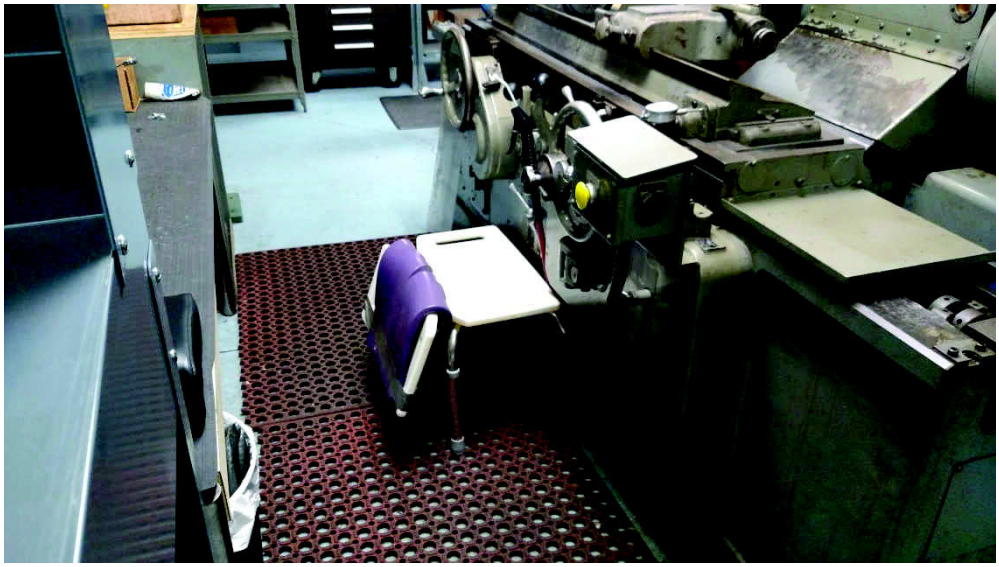

Figure 1

We found a handicapped shower seat (figure 1) and Cathy reconfigured it so that what was normally the back rest of the seat, now dropped from the seat towards the floor. We then pushed the apparatus against a machine, positioned her feet just under and her shins just against it as a shin rest. Within minutes Cathy was professing the benefits of this discovery. Next came some padding we taped on to shin rest and it was functional. Although this device completely bulky

and unsecure, it was functional. Our lives changed at that instant. We recognized the need to develop this idea and we took to the web and began the research we describe here. After using the initial prototype for two weeks, Cathy reported that her toes were no longer clenching. By touching her shins to the support, her body sway was controlled which relaxed her core muscles which relieved the fatigue throughout her body.

Figure 2

Figure 3

We continued to develop and refine our device through numerous prototypes (figures 2 & 3) made up of many inexpensive and readily available materials. As the research continued and we developed a more complete understanding of balance, stability and cognitive thinking, we continued to advance our prototypes. Our bodies began to feel more relaxed and we started to notice improvements in our overall posture and mood. We tested to determine the best angle for support of the shin while standing which is approximately 73 degrees (figure 9), eliminated any impairments of ingress or egress to or away from our machines by insuring our feet move freely under the shin support, designed adequate way of

securing force against the support in numerous configurations and attachment types, determined the appropriate height as to not allow contact at our knees and so on. By the time we had developed our third prototype in late October 2015, we were convinced that we had developed an idea that may very well impact the human race for evermore and in November 2015, we submitted our provisional patent.

Figure 4

Figure 5

By March of 2016, we had placed prototypes on nearly every machine we own (figures 4, 5) and the natural corrections to the poor posture we once had were unmistakable from the initial start of use (baseline figure 6), four months of use (figure 7) and ten months of use (figure 8). We found ourselves working more accurately, working longer hours, and we even took a stand alone prototype home to continue our trials.

Figure 6
Baseline

Figure 7
4 months

Figure 8
10 months

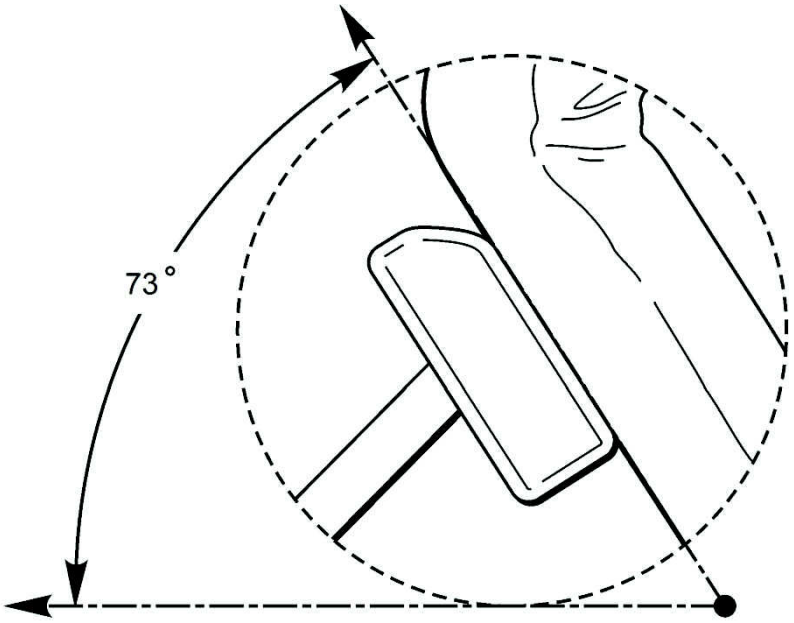

Figure 9

This depiction (figure 9) from our utility patent shows the approximate angle between 70-80 degrees from vertical, we found to be most beneficial in providing relief and sustainable durations in a stationary standing position.

We foresee the use of this device by nearly every person who performs sanding tasks in nearly every sector. Just a few examples are listed in Table 1.

Table 1

Manufacturing	**Education**	Boarding
Machining	Auditorium Speaking	Passenger Waiting Areas
Machine operation	Podium	Security Check Point line
Assembly	Classroom Teaching	**Government**
Quality Control station	Standing Desk	Public Service Employee
Plant Work Desk	**Retail Sales**	Station
Shipping & Receiving	Cashier	**Public**
Desk	Bagger	Public Use Railings
Industrial	Stocking Carts	**Agricultural**
Welding	Sales Window	Feed Stations
Shipping & Receiving	**Food & Drink**	Observation Stations
Assembly	Drive Through Station	**Sports and**
Print Table	Bartender	**Entertainment**
Meeting Room Podium	Cashier	Ticket Station
Health Care	Kitchen Stations	Vendor Service Station
Patient Rehabilitation	**Research &**	Gamers and Gamer
Surgery OR	**Development**	Stations
Patience Beds	Laboratory Stations	**Residential Applications**
Nursing Station	Auditorium Speaking	Kitchen Cupboards
Nursing Carts	Podium	Kitchen Island Prep
Patient Examination	**Transportation**	Areas
Room	Baggage Claim	Laundry Room
Dentistry	Ticket Sales	Garage Work Bench

In June 2016 we submitted our Utility Patent and began design of the production prototype. Production is scheduled to be underway before the end of 2016.

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