

Musculoskeletal Disorders

Five Common Management Approaches

By Walt Rostykus, Winnie Ip and James Mallon

No matter what you call them, cumulative trauma disorders, repetitive motion injuries or musculoskeletal disorders (MSDs), soft-tissue injuries continue to be a major cause of loss in today's workplace. In 1713, Ramazzini (trans. 1964) made one of the first published mentions of these types of injuries as "diseases of those who do fine work." In 1917, Hamilton (1943) described a disorder called "dead fingers" affecting stone cutters using air hammers to cut and shape limestone, one of the first published recognitions of the effects of vibration on soft tissue.

MSDs have continued to affect workers over time. In the mid-1980s, safety professionals and employers realized that MSDs (a common term used in the U.S. for such injuries) were an increasing issue and began implementing controls. It is interesting to note that the terminology for MSDs is not universal. Boocock, Collier, McNair, et al. (2009), reviewed literature from 15 countries and found that the terminology used to describe MSD conditions in upper extremities lacked international consensus, which can add challenges when managing these disorders across global organizations.

Fortunately, the risk factors that cause MSDs, primarily awkward posture, high

force, and long duration and/or high frequency (Figure 1, p. 36), are well known, and a substantial body of credible epidemiological research provides evidence of these associations (NIOSH, 1997a; b). Although the limits for each of these risk factors vary by joint structure (e.g., shoulder, wrist, back), increasing combinations of these factors are tied to the increased risk of developing an MSD (NIOSH, 1997a; b). This evidence-based cause-and-effect association provides a reliable basis for effective MSD management.

In recent benchmarking studies, employers indicated that MSDs account for 24% to 75% of their recordable injuries (Humantech, 2011). Further investigation reveals that the strategies used to manage these injuries range widely from reactive to proactive, and are based on various approaches, including changing personal wellness, fitness and employee work behaviors, and changing the workplace to better fit employee capabilities.

IN BRIEF

- Strategies used to manage musculoskeletal injuries range widely from reactive to proactive, and are based on various approaches, including changing personal wellness, fitness and employee work behaviors, and changing the workplace to better fit employee capabilities.
- This article summarizes five commonly used approaches by examining the pros and cons for each, and the investment needed and value returned of each. Their effectiveness and application in industry are reviewed as well.

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Figure 1

Primary MSD Risk Factors



The risk factors that cause MSDs are well known and widely researched.

Through benchmarking studies, work with global companies and review of published research and articles, the authors and colleagues identified various approaches used to address and control MSDs, then selected the top five most common approaches:

- Fix the person.
- Fit the person to the task.
- Change the person.
- Change how the person performs work.
- Change the work and workplace.

This article summarizes each approach. It examines several pros and cons, illustrates the investment and value of each approach, and contrasts their

effectiveness. The goal is to broaden SH&E professionals' perspectives and understanding of MSD management methods, and to help them identify new opportunities to better manage these losses.

Common Approach #1: Fix the Person

When an employee experiences an MSD or sprain/strain injury, an employer must provide the injured employee with diagnosis and treatment, then manage the return-to-work process. This is medical management, a reactive program designed to care for injured employees and reduce losses (time and financial) related to the injuries.

Medical management applies to all workplace injuries and illnesses, not just MSDs. Typically, this approach depends on and is best supported by healthcare providers (occupational nurses and doctors) qualified in occupational health and MSD management. Fortunately, healthcare providers experienced and qualified in MSD diagnosis and treatment follow established, common and accepted protocols (Decina & Bojanic, 1993; Herington & Morse, 1995).

This approach of diagnosis, treatment and return to work is focused on attending to the individual worker's needs. The process used, as well as its effectiveness and efficiency, can be greatly influenced (positively or negatively) by several other operational factors, including the system for funding and tracking occupational injuries (workers' compensation system or government-sponsored healthcare); method and requirements for classifying workplace injuries; speed of injury reporting; aggressiveness of treatment and return to work; and ability to find/accommodate tasks for return-to-work programs and resolve injury causes.

All employers should at least have a system for the medical management of MSDs. This reactive approach is most effective when the program integrates immediate and detailed injury/illness investigations to find injury causes and initiates corrective action. An effective medical management program typically features strong working re-

lationships and coordination between medical staff and those conducting investigations. Physical and occupational therapists may also be engaged to assist with treatment and return-to-work processes. These healthcare professionals diagnose and treat individuals of all ages with medical problems or other health-related conditions that limit their abilities to move and perform functional activities in their daily lives (American Physical Therapy Association, 2013).

Benefits of the medical management approach include the following:

- Responses to and management of reported injuries/illnesses are quick.
 - Aggressive management can reduce injury costs.
 - Resources are focused on known losses.
 - Injured employees receive focused treatment.
- Primary challenges of this approach are that it:
- is reactive; action is taken only after an injury has occurred;
 - does not prevent loss and cost of the injury; it only aims to minimize it;
 - focuses on one job or workstation (exposure) at a time.

This approach provides value in that it helps treat the injured employee and reduce associated costs of recovery. The investment in time and services is high (medical and return-to-work expenses); actual cost and treatment requirements are not well defined initially; and the approach does not identify or address the next source of MSD injury (prevention). However, reactive programs are essential for responding to any injury, including MSDs, when they occur.

Relying solely on this model may be the only approach that works for organizations with non-standard work tasks, high employee turnover, no available internal resources (safety personnel or engineers), and little opportunity to influence tool and workstation design.

Common Approach #2: Fit the Person to the Task

To reduce the incidence of strain injuries, many organizations try to match a current or prospective employee's capabilities to the physical demands of the workplace—in other words, fit the person to the task. This approach relies on measuring a person's functional capacities (e.g., strength, reach, range of motion, maximal oxygen consumption), then matching the person to requirements of the work as determined by the findings of a physical demands analysis.

This is a preventive approach. Employers must invest additional time and services to conduct functional capacity analyses and prework screening exams to match the physical demands of each job description. The approach typically requires hiring physical or occupational therapists to conduct a functional capacity exam (FCE) to "provide an objective measure of a patient's/client's safe functional abilities compared to the physical demands of work" (American Physical Therapy Association, 2013).

Proof that this approach is effective ranges from anecdotal reports in trade magazines and on websites to published research studies. The results of studies vary widely, ranging from “no difference” to “significantly lesser” to “prevents 47% of future MSD (and other) injuries,” provided the physical demands and functional capacity tests are accurate representations of exposures at work (Anderson & Briggs, 2008; Dueker, Ritchie, Knox, et al., 1994; Rosenblum & Shankar, 2006). In a review of nine published studies, Mahmud, Schonstein, Schaafsma, et al. (2008), conclude that “there is very low quality evidence that preemployment examinations that are specific to certain jobs or health problems could reduce occupational disease, injury or sickness absence.”

A job-matching program should involve both human resources personnel and a qualified healthcare provider (physician, occupational therapist, physical therapist); use reliable and valid methods for conducting FCEs and physical demands analyses; and require basic knowledge of federal and state employment law because a fine line exists between job placement and discrimination. The Americans With Disabilities Act does not prevent employers from conducting physical agility and physical fitness tests on employees or job applicants. However, employers cannot require medical examinations unless they are shown to be job-related and consistent with business necessity.

Thus, a job applicant can be subjected to medical examinations only after s/he first receives a conditional offer of employment that cannot be revoked unless the examination demonstrates that the applicant is unable to safely perform all of the position's essential job functions (Zuccarello & Paul, 2011).

Benefits of this approach include the following:

- Screening may identify an employee's or job candidate's preexisting conditions.
- It illustrates to employees their own physical capabilities.
- It forces employers to measure and understand the demands of their workplace and tasks.

The drawbacks are that it:

- must be administered correctly and properly in the U.S. to avoid violating the Americans With Disabilities Act;
- involves high investment in time and cost for screening by a qualified professional;
- provides low payback or return;
- is dependent on the quality of testing to truly reflect the physical demands of the entire job task;
- does not change or affect causes in the workplace;
- requires reassessment whenever jobs change;
- focuses on the person, one at a time.

Starting in the 1960s and continuing into the early 1980s, many employers favored the practice of matching employee capability to task conditions, but its popularity appears to be waning. In the authors' experience, 10% to 30% of U.S. companies still use this approach. In addition, it is encouraged in parts of Canada, where physical demands analyses are recommended by the Oc-

cupational Health Clinics for Ontario Workers Inc. (2013) when returning injured employees to work. In this case, matching the person to the task is part of a return-to-work program.

Organizations that use this approach are typically engaged in manual material handling and field tasks that provide limited control over workplace conditions (e.g., warehousing, stocking and order picking, driving and delivery tasks, emergency services).

Common Approach #3: Change the Person

Some organizations aim to prevent MSDs through activities designed to change an individual's capabilities, fitness and stamina. This is an investment in employees' fitness and wellness.

American College of Occupational and Environmental Medicine (ACOEM, 2011) promotes the concept of integrated health protection (safety) and promotion (wellness) in the workplace. This approach is not focused just on MSDs, but on overall employee health and wellness.

Some organizations rely on stretching, exercise and conditioning programs (alone or in combination with other interventions) to change an individual worker's physical condition with the aim of preventing MSDs. This approach relies on changing each employee's physical condition and capabilities, and depends on many variables that are outside an employer's control, including employee willingness, interest and participation; an individual's physical condition and preexisting conditions; and the design of the exercises to match workplace demands.

In the U.S., employers that use exercise and stretching to manage MSDs must ensure that they are promoting preventive exercise, not therapeutic exercise. OSHA (2010) interprets therapeutic stretching as follows: “If a physician or licensed healthcare professional recommends therapeutic exercise in response to a work-related injury or illness, the case is considered to involve medical treatment and the case is recordable.”

Many studies have examined the effects of stretching on the performance of athletes, and most results have been generally positive. However, the workplace and physical condition of employees (and an employer's control of employee physical condition) are different. In a review of three studies, Hess and Hecker (2003) conclude that the results suggest that worker health was enhanced and injury severity and costs decreased. However, the studies “failed to definitively prove the case for or against stretching.”

Similar studies and literature reviews have drawn the same conclusions that results were “not very compelling,” were mixed and suggested future studies with improved validity (Costa & Vieira, 2008; McGorry & Courtney, 2006; Silverstein & Clark, 2004). Choi and Woletz (2010) conclude that “while research does support that stretching improves flexibility, range of motion (ROM) and self-worth, stretching alone might not prevent work-related musculoskeletal disorders and injuries.”

Although some companies mandate stretching before and during work, many state that it is chal-

To find the right combination of approaches, a company must consider many factors, including site culture, amount of workplace control, ability to change the workplace and available resources.

lenging to get people to participate in (and continue with) these programs. In an early study on the effects of exercise on MSDs, Silverstein, Armstrong, Longmate, et al. (1988), report that only 41% of the study group participated in the exercise program daily, while 28% had discontinued all participation.

Exercise programs alone will not reduce MSDs. Proponents of stretching and conditioning identify that these fitness-based approaches are effective only when combined with other interventions (Liberty Mutual Group, 2009; McGorry & Courtney, 2006). Many results published in trade magazines and on the Internet share anecdotal cases of organizations reporting a 15% to 80% reduction in injuries over the course of a long-term stretching program. Finally, the activities of any stretching or conditioning protocol should be tailored to tasks performed and physical demands presented (task-/job-specific stretches). Companies must also be mindful of preexisting conditions and tailor exercise and stretching protocols accordingly. Generic programs can exacerbate issues if the stretches are counter to the physical demands of the work.

Reported returns on investment from stretching programs vary greatly. For example, Hess and Hecker (2003) evaluated one study and conclude that the “cost-benefit of stretching in workplaces where ‘time is money’ is negative.”

Potential advantages of stretching, fitness and conditioning activities are that they are:

- visible;
- demonstrate a level of commitment to employee health;
- provide employees with short breaks from work;
- increase each employee’s awareness of personal physical fitness.

Drawbacks are that such activities:

- have not been proven effective by valid studies;
- do not reduce conditions that cause MSD injuries (high forces and weights, awkward postures);
- decrease productivity by taking people away from work;
- may expose vulnerable individuals to increased chance of injury;
- require high investment of funding and time (e.g., employee time, program development, program reinforcement);
- are a challenge to sustain over time and through business cycle changes;
- allow employers limited influence on employees’ personal health and wellness, and employers have no control over employees’ preexisting conditions.

This preventive approach is typically supported by athletic trainers, physical therapists and occupational therapists. Athletic trainers are “healthcare professionals who collaborate with physicians to optimize activity and participation of patients and clients. Athletic training encompasses the prevention, diagnosis and intervention of emergency, acute and chronic medical conditions involving impairment, functional limitations and disabilities” (National Athletic Trainer’s Association, 2013).

The exercise and stretching approach works well for organizations with limited ability to change workplace setup and configuration, the flexibility to interrupt work and devote time to exercise, a strong team culture, and a strong commitment to and investment in employee wellness and fitness. This approach is used regularly in construction, baggage handling, package delivery, heavy assembly and manufacturing settings.

Common Approach #4: Change How a Person Performs Work

Some employers also endeavor to change how people behave or perform work tasks to reduce exposure to MSD risk factors. This approach relies on behavioral modification, typically through behavior-based safety (BBS) programs, work practice training and awareness campaigns that stress and reinforce the use of proper body mechanics.

SH&E professionals know that behavioral safety is an administrative control that should be adopted only after engineering controls (workplace changes) have been implemented and exposures to workplace hazards have been reduced to the lowest level achievable. This behavioral approach relies primarily on employees changing their perceptions of work and risk, changing how they perform work, overcoming existing work practices, and sustaining these changes throughout the work shift, work week and their careers.

This approach is supported and promoted by behavioral safety experts, psychology professionals, fitness specialists and trainers, yoga instructors and even martial arts experts, all providing services and systems to train employees in the use of body mechanics and motions. A review of research studies found no concrete evidence of the effectiveness of this approach in reducing MSDs. However, several websites and trade publications have published subjective reports of the effectiveness of behavioral approaches in reducing overall injuries (not specific to MSDs). For example, in a review of published studies, Goggins, Spielholz and Nothstein (2008) report that the cost effectiveness for MSD reduction realized by companies relying on behavior change is only 10% to 20%.

The advantages of this approach include:

- Conducting only the training or establishing an ergonomic behavioral/movement program separate from a comprehensive BBS program requires only a low cost involvement.

- Employees generally like it (they get a break from work and are doing something different).
- Employers view it as a low-risk option.

However, this approach has several drawbacks:

- Effectiveness and payback are low. Even when behaviors do change, they rarely have a significant effect on preventing exposure to MSD risk factors.
- Despite the low implementation cost, evidence shows that cost effectiveness is low (10% to 20%) (Goggins, et al., 2008).
- Programs are difficult to sustain.
- The validity of this approach is not proven.
- It does not affect MSDs causes.

•Managers have expressed frustration in getting people to participate in the programs and to use safe work practices, which requires additional management time and effort to enforce.

This approach works well for organizations that cannot or choose not to change the workplace, have time available to teach and engage employees, and have an existing behavioral safety observation program. It is also frequently used in organizations with nonstandard work environments. Several strong programs exist in the hotel/motel and entertainment services industry; distribution, packaging and cartage tasks; trucking and delivery operations; and construction.

Common Approach #5: Change the Work & Workplace

Occupational ergonomics involves changing the workplace and work design to fit the people performing the work. NIOSH (1997) defines *occupational ergonomics* as “the science of fitting workplace conditions and job demands to the capabilities of the working population.” This engineering- and design-based definition is consistent with other internationally recognized professional associations and organizations (e.g., Board of Certification in Professional Ergonomics, International Labor Organization).

The concept of designing workplace conditions and job demands to fit workers’ capabilities aligns with the OSHA Act’s General Duty Clause, which requires employers to “furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees.” Simply put, by practicing good ergonomic design, employers will provide a workplace that reduces exposures to MSD risk factors.

The approach to managing ergonomics in the workplace has changed significantly from the early days when OSHA (1991) released its “Ergonomics Program Management Guidelines for Meatpacking Plants.” This guide was a common resource for safety professionals beginning to address MSDs. A common current practice is to manage workplace ergonomics by focusing proactively on identifying and reducing the risk factors that cause MSDs (NIOSH, 1997).

This approach follows the continuous improvement process of plan-do-check-act: assess the risk, implement controls, validate their effectiveness and standardize the controls. This approach has been adopted and promoted by Brazil (NR-17), Canadian Standards Association (2012) and AIHA (2008) (Santos & Neto, 2012). Regardless of the model on which a program is based, “the main focus of a comprehensive ergonomics program is to make tasks, jobs, products, environments and systems compatible with the needs, abilities and limitations of people, as opposed to making the people compatible with the work characteristics and demands” (Costa & Vieira, 2008).

Diagnosis is the first step to identify and measure workplace exposures to MSD risk factors. The primary risk factors are awkward posture, high force,

and high frequency and/or long duration (NIOSH, 1997). The limits for each factor vary by each joint of the body due to its anatomical structure. A combination of two or more risk factors increases the chance of developing an MSD. Valid and proven assessment tools are available for whole-body exposure, as well as segmental exposure and specific risk factors.

Effective assessment tools use quantitative measures to identify and determine the exposure to risk factors that contribute to MSD development (Marras, Allread, Burr, et al., 2000; Marras, Fine, Ferguson, et al., 1999; Paquet, Punnett & Buchholz, 2001; Törnström, Amprazis, Christmansson, et al., 2008). For example, the NIOSH lifting equation is used to evaluate the back during lifting tasks while the rapid entire body assessment is used to evaluate exposures to all joints of the body.

The usability of qualitative and quantitative assessment tools has evolved to a point at which nonsafety, ergonomics or medical professionals can conduct MSD risk assessments effectively. In one study, Winnemuller, Spielholz, Daniell, et al. (2004), found that 81% of supervisors and 77% of workers completed ergonomic risk assessments that were in agreement with those completed by an ergonomist. The bottom line is that MSD assessment and management can and should include people across an organization, not just an ergonomics professional.

Changing the workplace depends on people in engineering roles (e.g., engineers, maintenance personnel) and engineering controls (adjustments and changes in the physical workplace) to ensure that reach, force and distance are within acceptable limits of the collective workforce. This requires designing the workplace to fit the 5th percentile female to the 95th percentile male to prevent exposure to MSD risk factors for all workers. Many studies have proven this approach to be effective and efficient (Doughrath & Rosecrance, 2004; Gilad & Einekave, 2007; Ip, 2009).

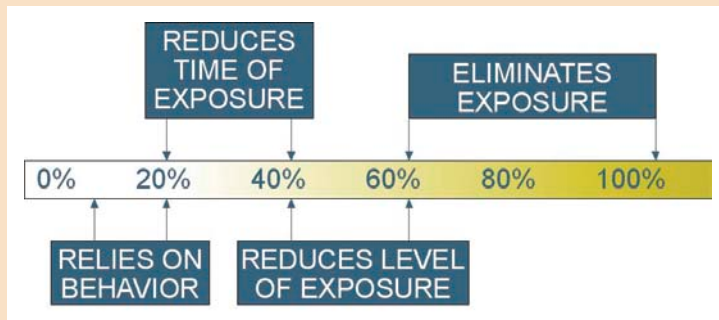
Administrative controls include changes to work planning, such as job rotation, rest breaks and slowed pace. These controls depend on people and can create additional challenges for managers and supervisors as they try to rotate employees or change their work tasks. Furthermore, administrative controls do not reduce or eliminate the presence of MSD risk factors; they simply reduce the exposure time (high frequency or long duration) when managed correctly by exposing more people to the risk factors for shorter periods of time. Job rotation will not prevent MSDs (Triggs & King, 2000). In addition, Schneider, Davis and Jorgensen (2005) caution that since the objective of a job rotation scheme is to minimize the risk to all workers, not just one specific worker, it may fail if the exposures to all MSD risk factors across all body regions are not adequately balanced.

Goggins, et al. (2008), reviewed 250 published case studies on the reported benefits of ergonomics programs and control measures. Their findings validate the hierarchy of controls as applied to im-

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Research validates the hierarchy of controls as applied to improving ergonomic conditions in the workplace.

Figure 2 Cost Effectiveness of MSD Risk Factor Controls



Note. Adapted from "Estimating the Effectiveness of Ergonomics Interventions Through Case Studies: Implications for Predictive Cost-Benefit Analysis," by R. Goggins, P. Spielholz and G. Nothstein, 2008, *Journal of Safety Research*, 39(3), pp. 339-344.

proving ergonomic conditions in the workplace. These researchers found that the cost effectiveness of several MSD controls were as follows (Figure 2):

- Eliminate exposures to MSD risk factors (engineering controls): 60% to 100%.
- Reduce levels of exposure (engineering controls): 40% to 60%.
- Reduce time of exposure (administrative controls, or breaks and rotation): 20% to 40%.
- Rely on behavior: 10% to 20%.

Support and engagement in effective ergonomics processes depend on involvement by people across an organization. Ergonomics/safety teams effectively conduct assessments. Employees bring expertise to cross-functional teams working on controls that reduce exposure to MSD risk factors. Engineering and administrative controls are best supported by engineers, maintenance personnel and professionals qualified in ergonomics.

Many organizations are working toward or have achieved a proactive ergonomics process to identify and manage exposures to work-related MSD risk factors. Such organizations have utilized the other approaches discussed, but have not achieved desired results. They have control over their workplace to make changes, and the necessary attitude and support. In addition, these are organizations that can and do change the workplace to reduce MSD risks, are open to making and funding changes, realize that the investment in equipment and changes will pay off, and integrate the change process into their normal methods of business.

In a review of 45 empirical studies, Neuman and Dul (2010) conclude that applying ergonomics (human factors) in operations system design supports improvement in both employee well-being and system performance in several manufacturing domains. Examples of organizations applying ergonomics to manage MSDs include offices and call centers; production and manufacturing facilities; processing, fleet and delivery operations; healthcare

and laboratory settings; and heavy manufacturing.

Beyond that, several organizations have standardized the proactive approach of managing ergonomics and have moved upstream to an advanced level. Advanced operations are characterized by evaluating the ergonomics of future products, processes, tools, offices and layouts, and designing future operations to fit the capabilities of those who will work there.

Simply put, this is prevention through design. It requires the ergonomics process to be applied upstream to engage product designers, process engineers and space planners. When provided with the right criteria, designers of future

products and processes can design correctly for the working population and prevent the introduction of MSD risk factors in the next-generation workplace. The cost to design new tools, processes and equipment correctly the first time is about 1% to 10% of the cost of retrofitting the workplace later (Charlton & O'Brien, 2002).

Advantages of this proactive approach include the following:

- Causes of MSDs (risk factors) are identified and controlled before an injury and loss occurs.
- Risk reduction controls benefit all people working at a task, now and in the future.
- Engineering controls are sustained over time, positively affect employee behaviors and performance, and reduce the need for BBS program elements.
- Controls are reliable; they are not dependent on employee behaviors.
- Employee engagement in improvements ensures buy-in and change.
- A high return on investment (value) is realized. Although expense and capital costs accompany engineering controls, this investment is significantly lower than the costs of later MSD claims.

In addition, several challenges must be overcome:

- Perceptions of ergonomics must change.
- Engineers, maintenance, management and employees must be involved.
- Funding for engineering controls is needed.

The Right Approach for Each Organization

The key is to find the right fit for some or all of these approaches within an organization. Fit is based on many factors, including site culture, amount of workplace control, ability to change the workplace, available resources and resource commitment.

Another way to consider these approaches is to compare them with the maturity of the MSD management program. Through a series of benchmark-

ing studies, Humantech (2011) has identified four general levels of program maturity through which companies progress as they improve the effectiveness and efficiency of managing MSDs (Figure 3).

The five approaches discussed align with the maturity curve levels:

Maturity Curve Level	Approach
Reactive	<ul style="list-style-type: none"> •Fix the person.
Preventive	<ul style="list-style-type: none"> •Fit the person to the task. •Change the person. •Change how the person performs work.
Proactive	<ul style="list-style-type: none"> •Change the (current) work and workplace.
Advanced	<ul style="list-style-type: none"> •Change the (future) work and workplace.

Many approaches are available for managing MSDs in the workplace. A right fit exists for every organization, depending on current needs, work environment, company culture, teamwork and engagement, support resources, improvement goals and workplace exposures. A company may apply one, several or all of the reviewed approaches.

Researchers continue to investigate the effectiveness of each strategy. Most researchers continue to recommend that any strategy include the systematic application of ergonomics (administrative and engineering controls) (Amick, Brewer, Tullar, et al., 2009; Bowers, 2010; Hess & Hecker, 2003; McGorry & Courtney, 2006; Silverstein & Clark, 2004; Triggs & King, 2000). The final strategy described, changing the workplace, continues to be the most effective, efficient and sustainable approach. When done well, an organization becomes less reliant on the other approaches. **PS**

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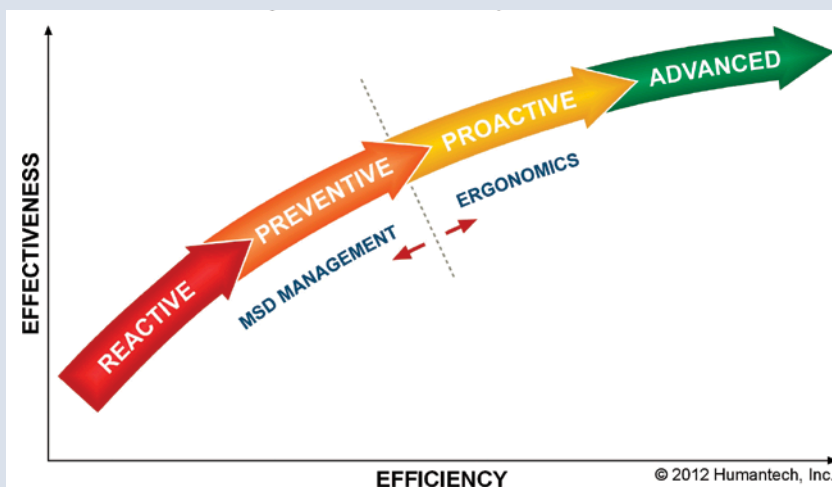
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Figure 3
MSD Program Maturity Curve



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