Front-End Analysis Plan
Reducing Common Running Injuries

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IDE 712 – Analysis for Human Performance Technology Decisions

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Overview

Throughout our history, running has become a very popular sport around the world. Some people run to lose weight, maintain their fitness, because it is fun, for competition, to relieve stress, for their profession, and many other reasons. Regardless of the reason people choose to run or must run, it is critical to remain injury free throughout training. Injuries cause people to gain weight, lose their fitness levels, lose their jobs, increase stress, and discourage people. According to the Health of the Force (2018), 14% of the force is considered not medically ready, 70% of this population is due to micro-traumatic musculoskeletal "overuse" injuries. There are several tools available to assist in preventing future possible injuries from occurring in order to eliminate or reduce this performance problem.

Performance Problem

According to a survey that was conducted by Athletic Net (2020), 6536 individuals participated in the survey and 94% of females and 91% of males experienced an injury or pain while running. In another report conducted by Bedingfield (2018), identified that in July 2018, there were 39,000 regular Army Soldiers who were non-deployable, which is equivalent to eight percent of the regular Army. In the Health of the Force (2018), in 2017 56% of Soldiers experienced a new injury and 17% were classified as obese, which resulted in 10 million limited duty days. If individuals lack the knowledge and skills for running, it can cause an unwanted injury, which will result in missing weeks or even months of training or work. Throughout this report, we will examine the current problem and desired outcome. Figure 1 is a graphical representation of the current states and desired state.

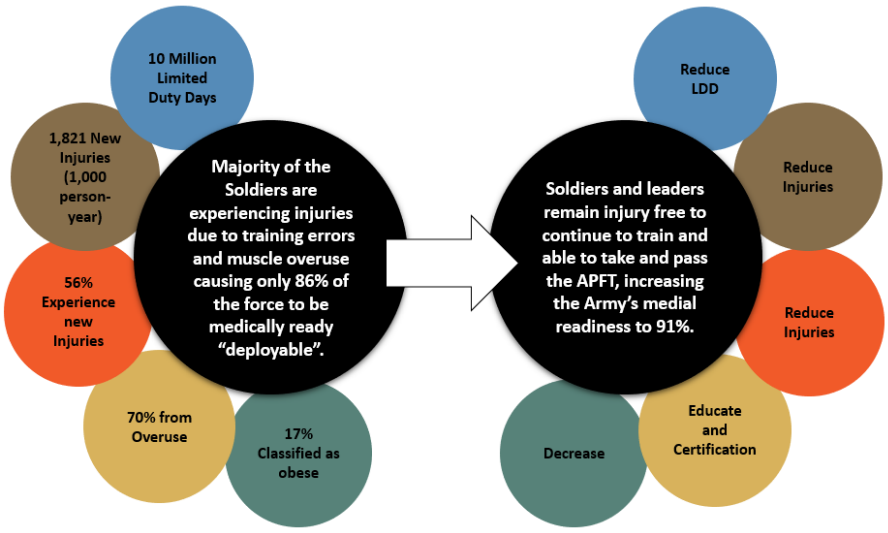

Figure 1

In the United States (U.S.) Army people are required to conduct physical training five times a week for 60 to 90 minutes each day and are required to pass the Army Physical Fitness Test (APFT) every six months. Part of this required training and fitness test, is being able to run. Soldiers that are injured cannot meet this requirement. Unfortunately, too many individuals are injured due to poor running form, incorrect/overused running shoes, training errors, overweight, environmental conditions, and lack of incentives and motivation. Additionally, there are several individuals that fail to achieve their individual running goals due to an injury that causes them to miss training days or even sometimes training weeks or months.

If unable to correct this performance gap, individuals that are serving in the U.S. Army will not be able to meet the fitness requirement and will not be combat ready or deployable. Furthermore, these individuals will be given restrictions and medication that could result in lower work performance. Individuals that have set personal running goals will be setback from training, which will interfere with meeting individual goals.

Purpose of the Plan

The purpose of the front-end analysis (FEA) plan is to explore the potential causes of this performance problem and assist in exploring possible solutions to close the performance gap from the current outcome to the desired outcome as represented in figure 1. The desired outcome is for Soldiers and runners to remain injury free to continue to train and be able to take and pass the APFT, increasing the Army's medical readiness from 86% to 91%. Therefore, Soldiers will be able to continue training, remain deployable, and achieve their individual running goals.

The FEA plan will identify some FEA tools that can assist in identifying the possible causes of running injuries individuals receive. These tools will provide the needed data to assist in preventing future running injuries for Soldiers and runners.

Affected Personnel

Injuries affect many people. This FEA plan will focus on injuries that are received from training, and that affect individuals from meeting a requirement or individual goal. The clients and stakeholders for this FEA plan are listed below.

- ✓ Soldiers: These individuals are personnel that are serving in the Army. This includes all personnel serving, regardless of age, gender, or pay grade, in the active component.

- ✓ Leaders: These are individuals that are responsible for training Soldiers or reporting training statuses to the higher echelon.

- ✓ Coaches: These are individuals that are training individuals to assist in meeting an individual goal or training members of their team.

- ✓ Runners: These are individuals that run for fun or as a recreational activity.
- ✓ Competitive Runners: These are individuals that run in competitive races, these can include races of all distances.
- ✓ Medical Personnel: These are the personnel that are responsible for seeing and diagnosing runners/Soldiers with running injuries.

Proposed Front-End Analysis Plan

In order to understand and identify the root cause of this performance problem that currently exists in the U.S. Army, a thorough FEA is needed. If successful, the FEA will assist in identifying the possible causes of the performance problem and it will assist in developing potential solutions to either eliminate or reduce this performance problem, thus meeting the desired outcome.

Front-End Analysis Methodology

The primary data collection tools that will be used are surveys (past and future), historical documents, interviews (with novice and experts), and observations (evaluations).

Subject Matter Analysis

One of the methods that will be used to assist with gathering the data that an individual must know to be able to perform at an optimal level is subject matter analysis. In an effort to gather this information, interviews will be conducted with individuals that already perform at an optimal level without any injuries, such as competitive runners. Interviews will also be conducted with experts, these individuals are the ones that have the knowledge and skills needed for optimal performance, such as coaches and trainers. Interviews will also be conducted with novice runners; this will allow them to gather data of the knowledge a novice runner has.

Another method that will be used to assist with gathering the data is advice from a combination of several professional runners and coaches. Examples are individuals like Dr. Jack Daniels and Coach Sage Canaday, both have years of experience in coaching and running.

Extant Data Analysis

Another method that will be used is the Extant Data Analysis. The primary sources that will be used to gather the facts and trends will be past surveys and historical documents and videos. The goal in this analysis is to gather the actual performance that has been occurring. Examples are surveys like the Athletic Net 2020 survey and previous written articles discussing increase in running injuries, like the article Musculoskeletal Injuries 2018, and the 2018 Health of the Force report.

Front-End Analysis Model:

The FEA model that will be used to assist in exploring the potential causes and solutions of running injuries will be the Harless Model. This model is composed of a series of smart questions that will assist in the performance analysis, cause analysis, and propose solutions. Asking these smart questions will ensure allocated funds are worth spending on the current problem, a thorough investigation is conducted to determine the causes of the problem and determine the most cost-effective solutions to solve the current problem. Below are the 13 smart questions along with the responses for each question.

	Smart Questions	Response
Performance Analysis	Do we have a problem?	Yes, according to the Army Public Health Center, 50% of military experience one or more injuries each year. At least half of these injuries are caused by running.
	Do we have a performance problem?	Yes, these injuries affect the training Soldiers are required to attend and complete to be prepared for future combat operations.
	How will we know when the problem is solved?	Reducing medically non-deployable population. According to Musculoskeletal Injuries (2018), these injuries account for 70% of this population. According to an article by Performance Triad, it is estimated that 27% to 70% of runners sustain overuse injuries during any one-year period (Running, 2018). We will know when this performance problem is solved when we increase medically ready percent from 86% to 91%.
	What is the performance problem?	Soldiers are getting injured, which affects the training Soldiers are required to attend and complete. They are also becoming medically non-deployable due to these injuries.
	Should we allocate resources to solve it?	Yes, injured Soldiers miss work, have work restrictions and become medically non-deployable. These injuries do have an effect in the overall readiness of our force.
Cause Analysis	What are the possible causes of the problem?	Poor/Improper running economy, incorrect running shoes, training errors (muscle overuse/over train), high body mass index, environment conditions, lack of incentives and motivation.
	What evidence bears on each possibility?	50% of the military experience one or more injuries each year. At least half of these injuries are caused by running.
	What is the probable cause?	Lack of knowledge and skills regarding proper running economy, proper shoe selection, proper training schedule development, proper nutrition and eating habits.
	What general solution type is indicated?	Instructional intervention, training and education on running economy, shoe selection, developing physical training plans, and nutrition.
	What are the alternative subclasses of solutions?	Provide job aids/infographics to assist with educating the population. These can be posters, or pocket size cards.

	Smart Questions	Response
Propose Solutions	What are the costs, effects, and development times of each solution?	The alternative solutions will be least expensive, but not as informative. Development will be easy and quick. The Army Wellness Center (AWC) already provides education for physical fitness and nutrition. They also use state-of-the-art equipment to conduct fitness tests and body composition tests. The AWC is already allocated funds to assist Soldiers with achieving their personal goals. Designing and developing an intervention plan for leaders and Soldiers to utilize the services offered by AWC can be effective and inexpensive. Although the AWC provides these services, it is unrealistic to have every individual use these services.
	What are the constraints?	Developing and implementing an instructional/training plan will take time. It will require Soldiers to take advantage of the services offered by the AWC and will require leaders to encourage and support subordinates of these services.
	What are the overall goals?	Reduce Soldier common injuries caused by running.

Front End Analysis Tools

The FEA tools that will be used in this plan are the gait analysis (or 3D gait analysis), AWC fitness test, and body composition test. According to the Athletic Net Survey (2020), the top two reasons why individuals get hurt is not running smart and wearing the wrong footwear. The gait analysis will not only assist in identifying improper running, but it will also tell an individual what type of shoe they should wear while running. These tools will assist in identifying potential causes of running injuries and it is the first phase of developing the appropriate solutions to correct this performance problem.

Gait Analysis

One of the primary purposes of the gait analysis is to assist runners in identifying any abnormal or improper running economy that may exist to prevent any future possible injury. According to a study from the University of British Columbia, "30 to 50 percent of runners get injured each year" (Kaplan, 2012, p. 1). The gait analysis can assist individuals in the Army by providing feedback and data on any abnormal or improper running economy that they may have. These abnormalities or improper techniques can cause running injuries that can be prevented. This tool can assist individuals on selecting the proper running shoe needed to assist in developing and improving their running economy. Additionally, the data collected and analyzed by this tool can be used by leaders to develop treatment or rehabilitation programs to correct any abnormality or improper running economy that may be causing an injury. Furthermore, this tool can assist new Soldiers in developing training plans that will develop critical muscles in the body needed for running and ensure new runners are remaining injury free during training.

AWC Fitness Test

The AWC offers several tests and services to assist Soldiers in meeting their fitness and health goals. One of the services offered is the "fitness test" which includes, the body composition test, the metabolic test, the cardiorespiratory fitness test, muscular fitness test, and flexibility test. These tests are all used to analyze a Soldier's fitness level, create individual exercise plans, and educate the Soldier on preventing injuries and living a healthy lifestyle.

Test	Explanation
Body Composition Test	The AWC is equipped with the Bod Pod, which is used to determine an individual's body composition. The Bod Pod measures the weight and volume of an individual to calculate an individual's body fat percentage.
Metabolic Test	Test that is used to measure an individual's energy expenditure. This test will be able to tell an individual how many calories are used by your body on any given day. Does not calculate/include workout calories.
Cardiorespiratory Fitness Test	Also known as the VO2 max test, it is used to measure an individual's maximum amount of oxygen they can utilize during exercise. Conducted on a treadmill with a breathing device.
Muscular Fitness Test	Strength and endurance exercise conducted to measure an individual's level of strength and endurance. This will help pinpoint areas of weakness or muscles that are vulnerable to injuries.
Flexibility Test	Ability to measure an individual's range of motion, limitation, imbalances, or instabilities.

Possible Causes of the Problem

There are many possible causes to this performance problem. Some possible causes to this problem can be due to a lack of knowledge and skills required by the individual to remain injury free and at the required fitness level. Other causes of this performance problem can be caused by the environmental conditions or they can be caused due to a lack of incentives and motivation.

Knowledge and skills

Poor Running Economy

Many people believe running is easy, just go out and run. This is not the case for most people. People need to understand and know the basic fundamentals to run properly and injury free. New recruits usually lack the basic skills and knowledge on proper running economy, in some

cases even seasoned Soldiers and leaders lack the skills and knowledge as well. According to an article by Performance Triad, most injuries that occur during physical readiness training are caused by inappropriate training and inadequate fitness (Workout Preparation and Injury Prevention, 2020). It is critical for Soldiers to have the knowledge and skills for the basic fundamentals for running economy and leaders need to observe and correct deficiencies as needed. Thus, leaders need to have a higher level of knowledge and skills to be able to effectively identify the improper biomechanics. Improper running form can be caused by poor nutrition, individuals that exceed their body mass index, individuals that smoke, and improper footwear.

Incorrect/Overused Running Shoes

There are several leaders and Soldiers that lack the knowledge in selecting the right running shoe. According to a survey that consisted of 6536 individuals, the number two reason they experienced an injury was wearing the wrong type of footwear (Athletic Net, 2020). The three basic types are neutral arch, low arch, and high arch. But there are also shoes like minimalist running shoes, which are shoes that have very limited cushion and support. Selecting the wrong shoe can cause an injury in the future as a shoe can change your running economy. The primary rule for selecting a running shoe is comfort, the shoe has to feel comfortable when you run (Running, 2018). Although selecting the right running shoe is critical, knowing when you have to replace the shoe is also just as important to remain injury and pain free. Just like any other type of equipment, there is wear and tear with time and mileage. Shoe replacement varies by the shoe type and the individual. Environment conditions also have an effect in shoe replacement along with the number of miles an individual runs during a training session, a week, or month. Therefore, it is vital for Soldiers and leaders to have the knowledge and skills to know how to select and when to replace their own shoes and those of their subordinates.

Training Errors

Probably one of the biggest causes with this performance problem is the inability or lack of skills and knowledge to develop and execute a training plan. According to a survey that consisted of 6536 individuals, the number one reason they have experienced an injury was not running smart (Athletic Net, 2020). Not running smart occurs when individuals lack the knowledge to develop an optimal performance training schedule. There are a number of types of exercises and running programs. Selecting and implementing the right one at the right moment can be challenging, especially if an individual does not know the differences. One of the major factors that increase risk for injuries is integrating a new strenuous training activity or restarting one after a rest period (Musculoskeletal Injuries, 2018). Many leaders and Soldiers lack the knowledge and skills to understand, explain, demonstrate, and create effective fitness training plans that will increase fitness and keep injuries at a minimum. This is specifically important for leaders to understand, especially when performing high intensity activities with individuals with different fitness levels. Leaders need to consider training cycles, block leave, and new Soldiers when planning and incorporating high intensity and the duration of the training session (Workout Preparation and Injury Prevention, 2020). Although the knowledge and skills are important to have, environmental conditions also play a role in managing and preventing running injuries.

Environmental Conditions

Weather

The weather can have an effect on running and also can cause running injuries. Individuals have to consider running against the wind, especially high winds, can have an effect on your running economy and increase the intensity of the training session as well. Temperature is another major factor and has an effect on running and can cause running injuries. According to Army Injuries, Causes, Risk Factors, and Prevention Overview (2018), cold or hot weather can increase risks for injuries. If it is too hot or too cold, an individual can lose their running form which then increases the chance of developing an injury. Falls or slips can cause an injury as well, runners have to be aware of these hazards when selecting the time and location of their training sessions.

Terrain

The location of a training session needs to be considered when developing a training schedule. As individuals develop training plans, terrain remains an important part of this process. According to Army Injuries, Causes, Risk Factors, and Prevention Overview (2018), rugged terrain can increase the risk for injuries. Developers need to consider the various types of terrain, for example, hard surfaces (road), trail running (dirt), hill training, and uneven terrain. Having a mixture is always great but focusing too much on one can result in overuse of the muscles and create an injury.

Incentives and Motivation

Organizations that do not provide the right incentives can cause running injuries to remain within their organization. Not providing positive influence can have a negative effect on training outcomes. According to a survey that consisted of 6536 individuals, the fourth reason they experience injuries is due to the negative outside influences (Athletic Net, 2020). Individuals that are maintaining and managing their weight, do not smoke, are extremely flexible, or more fit will less likely experience an injury. Individuals that remain injury free and focus on living a healthy lifestyle need to be acknowledged and rewarded by leadership. Not having established incentives can discourage individuals and reduce motivation within an organization, causing an increase in the behaviors that increase the risk of injuries. Furthermore, individuals must remain committed and have the desire to run. Individuals that lack motivation and are forced to run are more likely to experience an injury as they are not focused on performance, thus affecting their running economy.

Potential Solutions

Army Wellness Center

Improving the knowledge and skills of both Soldiers and leaders in the Army can have a positive effect in reducing and preventing running injuries. One of the primary sources to provide this education is the AWC. The AWC is staffed and structured with subject matter experts that can provide individualized exercise prescriptions, provide tailored strategies for losing, gaining, or maintaining weight, and offer classes to support and improve a healthy lifestyle. These subject

matter experts can provide the client with areas that need improvement upon completion of the fitness test.

Leader Certification

Another educational solution that is providing more available slots for educating leaders on physical fitness training. This course is already established, and it is attended to train and certify leaders as "Master Fitness Trainers" (MFT). Training at least 50% of the leaders will truly help reduce injuries by training leaders on developing training schedules and implementing exercises that focus on building the critical muscles to improve running economy. Currently the MFT course has two phases, an online portion and a two-week residence portion. Even requiring every leader to complete the on-line portion will assist in educating leaders in the Army, thus reducing and preventing future injuries.

Learning Tutorials

It is unrealistic to believe that every Soldier will be available and have the opportunity to use the services offered by the AWC and to believe that every leader will be able to attend the MFT course. To assist with this gap, creating short learning tutorials that can be accessed and available for Soldiers and runners will truly have a positive impact on educating the force. These tutorials can provide the appropriate instructions and demonstrate the behaviors and actions needed to perform the exercise or technique correctly. These learning tutorials should include the proper biomechanics an individual needs for optimal running economy, exercises that help develop the key muscles in running (focus on legs, core, and joint mobility), educating learners on selecting the best (for their running style) shoe for running, common training errors, selecting the best environmental conditions. At the completion of each tutorial, the client should be provided a job aid for quick and easy reference.

Job Aids/Handouts

Although the AWC offers several classes, it is unrealistic to believe that every member, including family members, will have the time and opportunity to attend these classes. Developing job aids, such as posters and pocket size cards, can be an inexpensive method to educate individuals on the basic fundamentals of proper running economy and how to select and replace running shoes. This is an easy method to implement, but less informative than instructional videos or lectures. It also does not allow the opportunity for questions and feedback.

Structure/Training Plan

Leaders play a critical role in the structure and development of a physical fitness training plan. Typically, the first sergeant (civilian equivalent to department manager/general manager) is responsible for structuring and developing the organization's physical readiness training schedule. The first sergeant's subordinate leaders are responsible for executing and evaluating the training plan. If these individuals are not properly trained, the risk of injury increases. Therefore, training and certifying leaders should remain a priority in an effort to reduce and prevent running injuries. Certifying leaders as MFTs can assist in certifying leaders but

developing an on-line course can also assist in educating a larger number of leaders. These courses can also serve as a recertification course as needed and include the educational tutorials that were previously mentioned.

Reward System

Establishing an award system to reward good performance is critical to establishing motivation and pride within an organization. Although, establishing the reward system is important, following through with the system is critical. Organizations need to have a system that not only rewards positive and productive work performance, but also reward the positive productive behaviors that increase performance. For example, according to Musculoskeletal Injuries (2018), one method to prevent these types of injuries is to live a healthy lifestyle, which includes exercise, proper sleep, nutrition, avoiding drugs, alcohol, and smoking. Individuals that live healthy lifestyles are less likely to get injured and should be rewarded for the positive and productive behaviors they display.

Figure 2 below shows each potential cause with the desired potential solution.

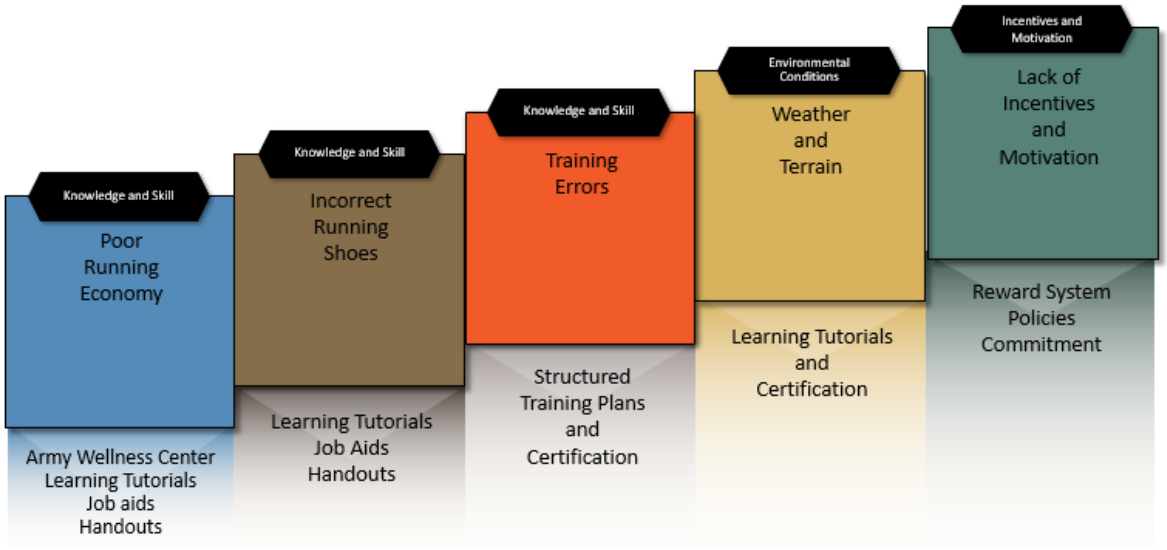

Figure 2

Conclusion

Regardless of the reason for running, an individual strives to run without pain and avoid injuries. These injuries cause people to gain weight, lose their fitness levels, lose their jobs, increase stress, and discourage people. The intent of this FEA plan is to assist with closing a current performance gap that exists within the Army and for recreational runners. The desired outcome is for Soldiers and runners to remain injury free to continue to train and increase the Army's medical readiness from 86% to 91%. If unable to correct this performance gap, individuals that

are serving in the U.S. Army will not be able to meet the fitness requirement and will not be combat ready or deployable.

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