



ERGONOMICS FUNDAMENTALS



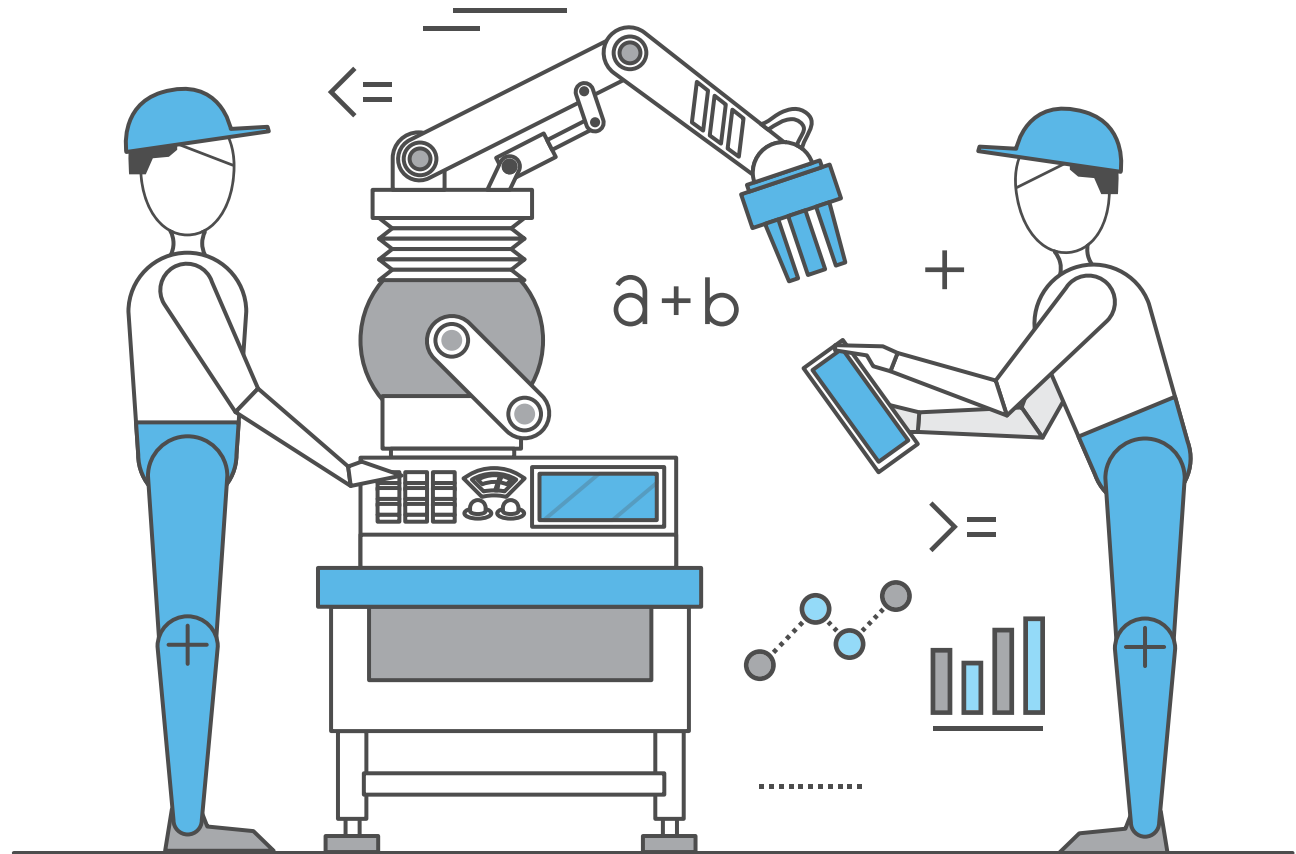
INTRODUCTION

Although ergonomics, as a science and designing criteria system, has been with us for more than a hundred years, there is still a great potential in it for mankind to develop. While a certain level of ergonomic design of everyday objects has already been pushed by the market, in case of factory workstations and workflows the supply labor market has so far not been able to do so. There have been several easier ways to increase efficiency. Mechanization, advanced organizational methodologies, as well as the transition of jobs to lower wage cost countries, have provided fuel for several decades to increase operational efficiency.

Mechanization and automation

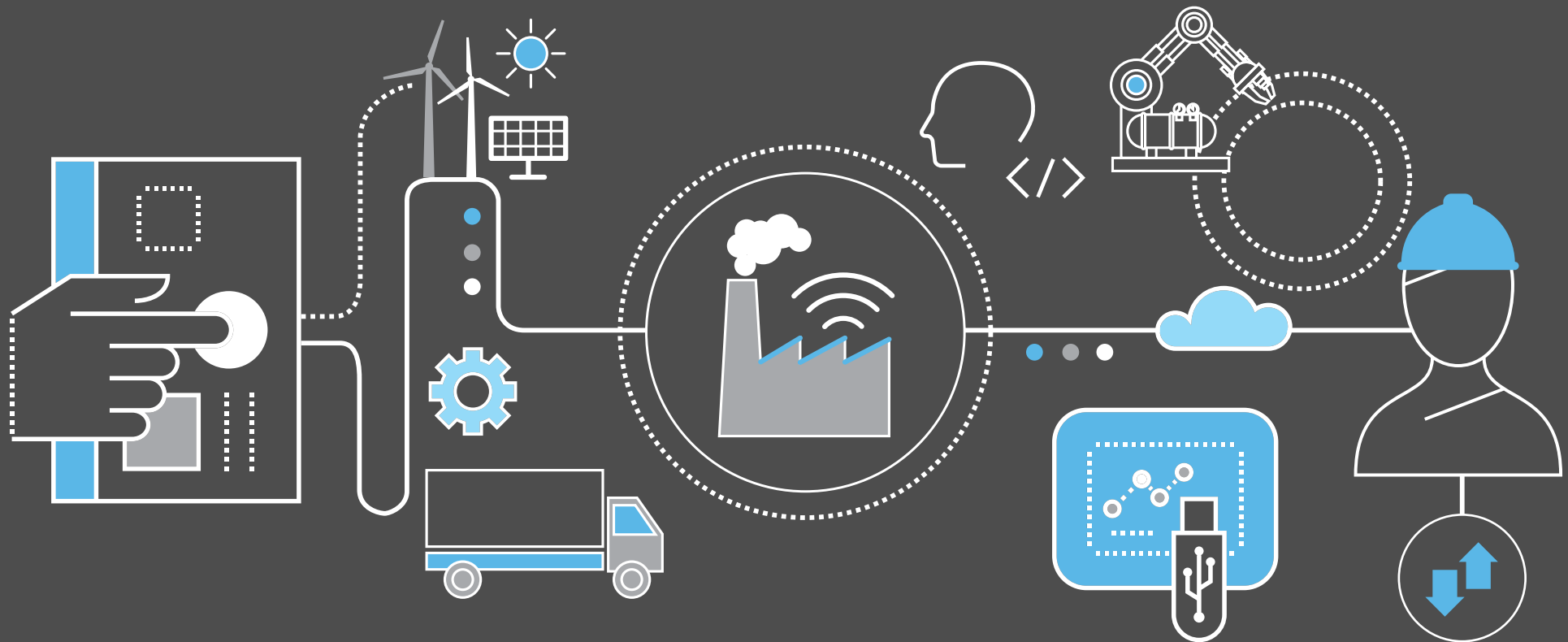
There is a huge potential in mechanization, so comprehensive robotization has been indelibly imprinted to the vision of humanity, according to the public opinion. In spite of that, the next steps on the road ahead are far from obvious. Though, due to the development of computing, today's robots would be able to handle much greater decision space than simple vending machines; they are still very far from real intelligence, which could replace the human intellect. (Especially if we do not talk about experimental specimens, but rather about affordable, serially produced robots.) The next era of robotization is likely to be about robots assisting humans by working together. A great example is a draught animal, which never leaves the winding road; or the shepherd dog, which barks three times when notices something unusual.

The new generation of smart devices already represents this trend. For the time being, the aim of the development of the driverless cars or the digital personal assistants is about to approximate the intelligence level of a draught animal or a lap dog. At the same time, there are only a very few examples of physical cooperation between human and machine. The warehouse forklifts are not yet replaced by extremely powerful robot assistants, and neither the firemen nor the policemen are accompanied by silly but obedient super assistants. At present, robotic workflows are considered to be a very dangerous concept; people cannot get close because of high accident risk, it is not an option yet to get involved. The design of powerful assistive robots would require a great depth of ergonomic design, which currently does not have a sophisticated methodology.



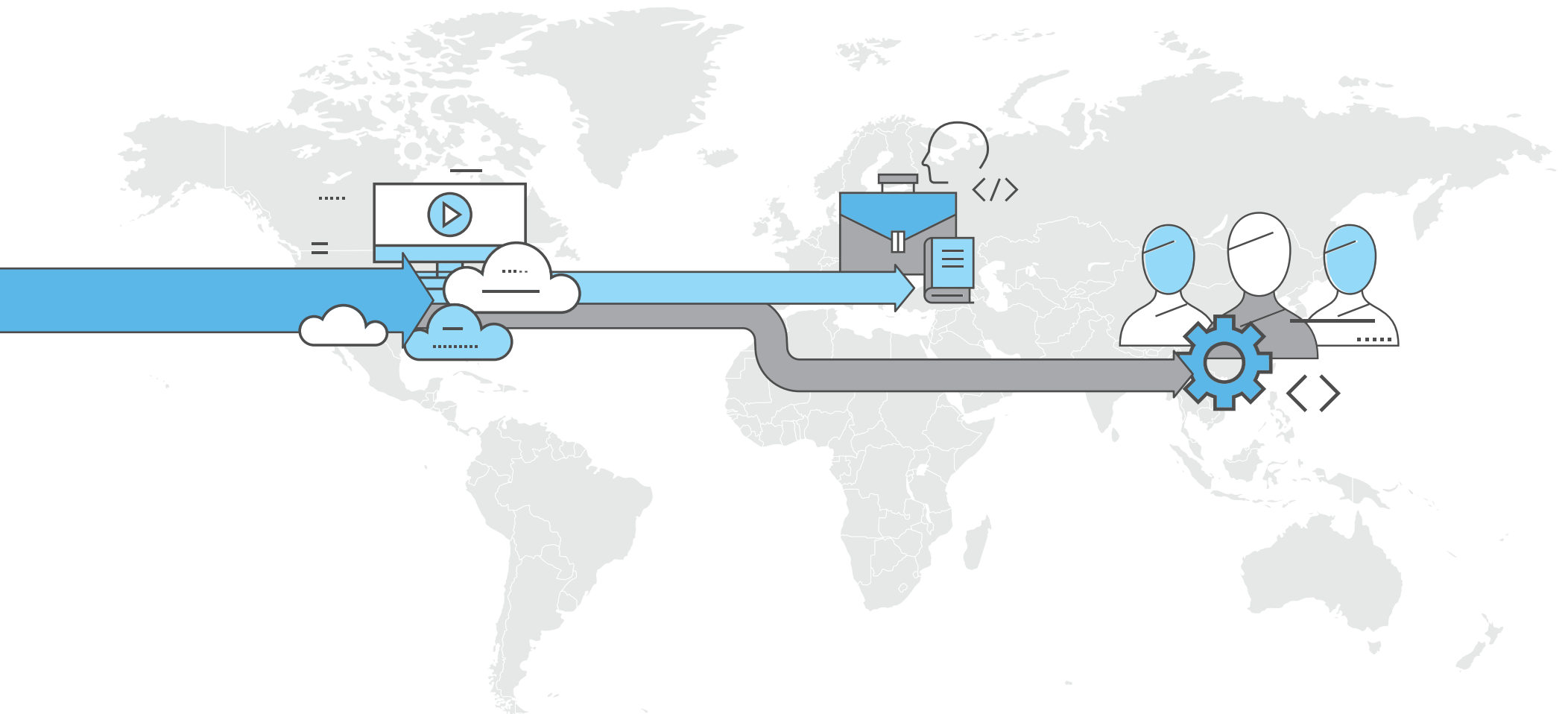
Lean production

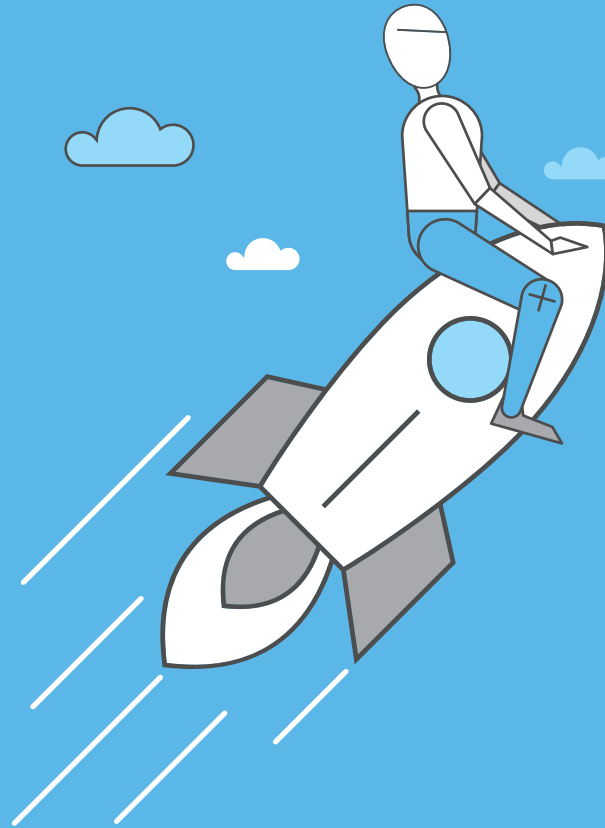
While the whole 19th and the first half of the 20th century were about mechanization, the post-World War II period was about the blooming of lean organizational methodologies. By now, the lean approach became established in almost every industry and organization. Therefore the reserve became limited in organizational structures and workflows. (Here the word reserve is a lean concept as well.)



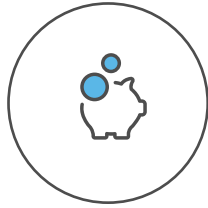
Outsourcing of manufacturing

The relocation of factories to the Far East, Latin America and Eastern Europe was an essential process of improving efficiency in recent decades. However, the signs of saturation started to show in the former destination countries, and although, theoretically, more countries can be considered as the destination of a next offshore wave, the inexpensive cheap labor in itself is not enough for this. Among others, there is also a need for social and political receptiveness, raw materials and adequate logistical connections. If we are only looking for cheap mass labor, then India, the poorer Middle East and many African and South American countries may be considered, but so far, none of them seems to be capable of replacing the breathless China.





BENEFITS OF ERGONOMICS



Cost optimization

Minimizing the probability of injuries can greatly reduce collateral costs. A sudden injury may easily result in temporarily halted or entirely stopped production lines. If not managed in time, these unused work hours can quickly pile up to high expenses on the company side. Such shortfalls may have a significant impact on both the business and production. Work injuries frequently tend to be accommodated with subsidiary costs such as compensations. Minimizing workforce fluctuation is one of the organizations best interest. By achieving this, businesses can maintain an optional employee count.

If a company loses too many employees, it will result in overloaded and thin stretched departments, as multiple tasks may require the same employee to be fulfilled simultaneously. Additional resources must be spent on managing recruits replacing the ones who recently left. The employee turnover requires not only expenses, but it also demands other workers' efforts for training the newcomers.

Unfilled job roles may generate hidden expenses as well, such as delays, errors and inefficient management in development, manufacturing, and delivery. Hidden costs act more like an unplugged hole, generating permanent loss till a certain role has been filled.



Better productivity

Comfort is key! Ensuring an optimal work environment will result in better performance in the long run. On the one hand, this can be the result of minimizing the probability of injuries, but it is also the result of creating a personalized work environment. The more your employees feel at home, the more relaxed they will be while performing their job.

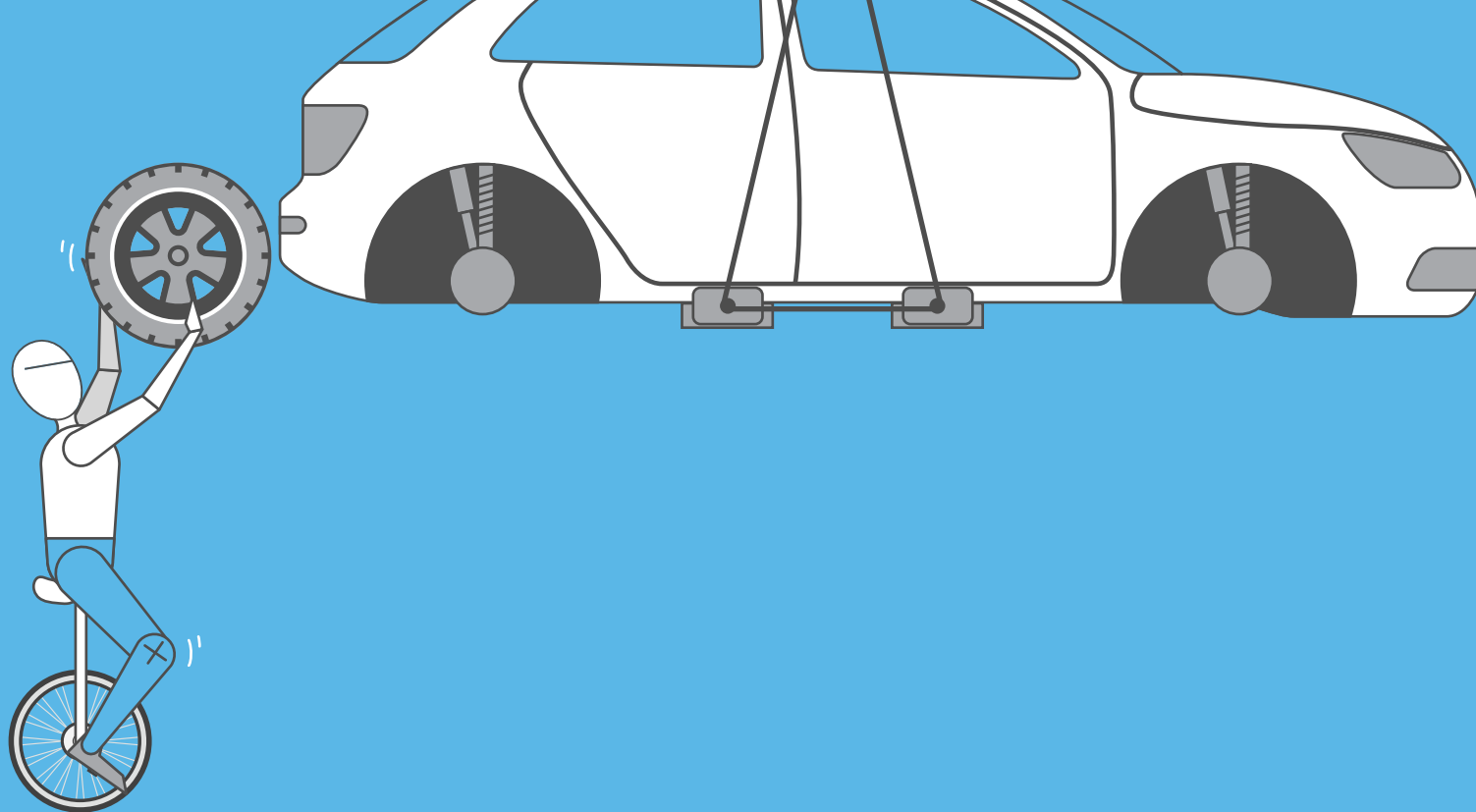
Productivity is also a measurement of the available equipment. Even someone who excels at his/her job can only do so much without proper equipment. Providing the necessary tools for processes significantly enhances productivity.



Better quality

The fewer employees lose focus, the better they perform. With less frustration, they have more motivation to concentrate on their tasks. Being in an uncomfortable situation caused by exhaustion or muscle stress may result in lower performance. Lack of focus also allows more room for errors as employees tend to cut corners just to get the job done a bit faster.

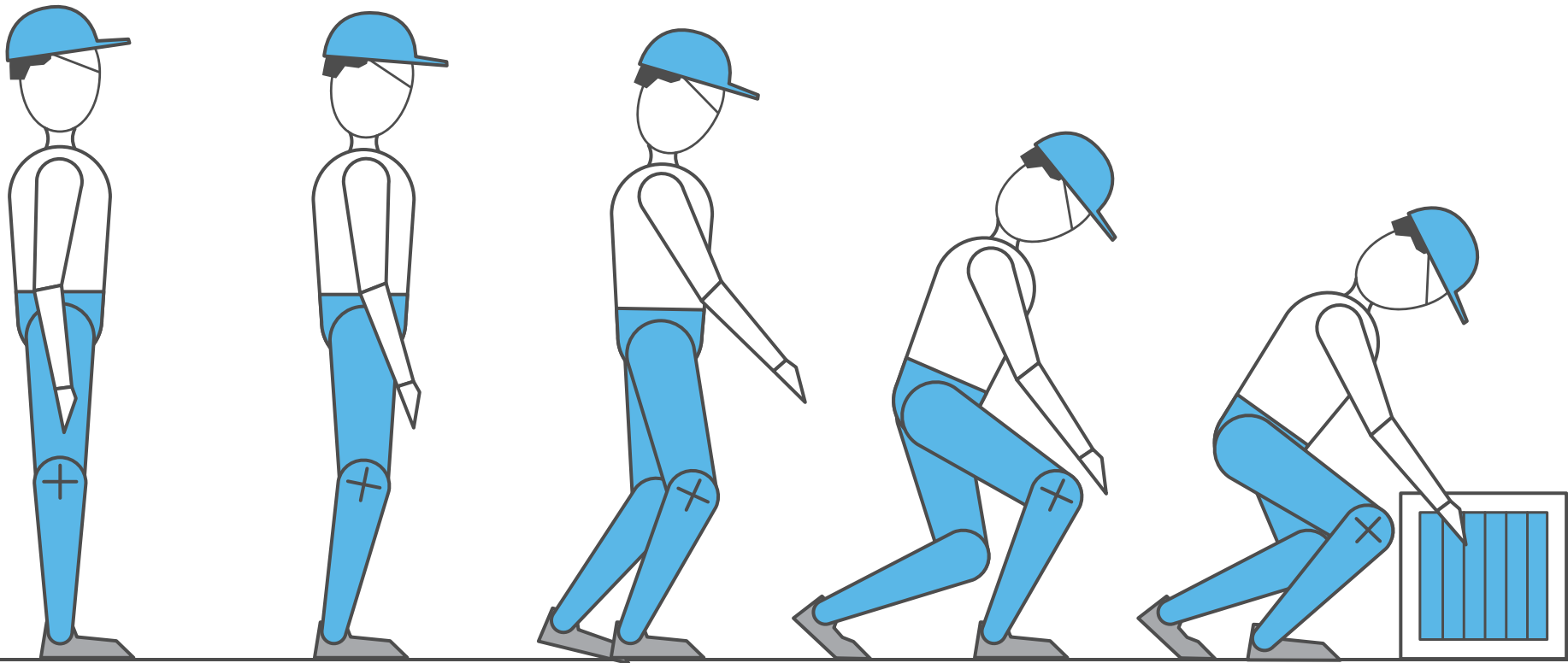
If you expect top-notch quality, employee focus must also be kept on a fairly similar level. This can be achieved by minimizing or terminating all forms of distractions, any risks or job hazards.



RECOGNITION OF ERGONOMIC RISKS

Repetitive motions

Repetitive work is a frequent occurrence in manufacturing, that's why it requires more attention. Any work cycle lasting longer than half a minute significantly increases the probability of errors. If the procedure is accompanied by any additional actions, the level of risk caused by repetition is expanding even further. In an ergonomically inconvenient workplace, repeating the same or similar stressful movements can result in nerve damage, pinching, joint stress, or muscle fatigue just to name a few. Identifying such dangerous working methods is key in minimizing the risks accompanying repetition. Short-term adjustments such as changing the workplace layout or mixing up the pattern of the tasks for the day can significantly reduce muscle stress generated from repetition. As a long-term adjustment, involving the use of additional automated tools or more customizable working equipment, can substantially enhance stress relief.



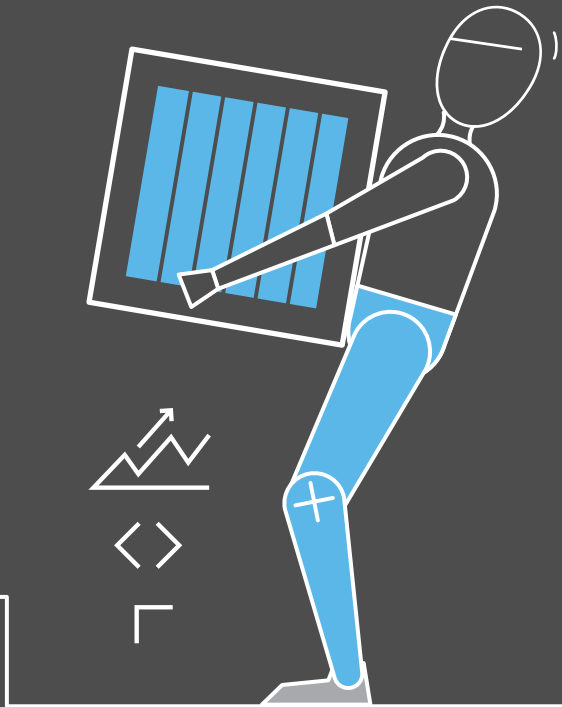
Physical exertion

Talking regardless of static or dynamic physical work in the event of an overload, muscle tissue, joints, tendons and bones can suffer severe damage if continuously in use for certain activities.

When muscles contract at or near their maximum, they fatigue more rapidly and the likelihood of damaging the muscle or other tissues involved in the activity increases.

Weight shifting is another aspect: When a worker is prepared for a particular weight limit yet the content differs from the expected, either too low or high, it can come off as an unexpected effort from the muscle. Experiencing this event multiple times can result in sudden injuries.

Inadequate recovery time is a general issue in work environments. By not having enough time for tension relief between work sessions, muscle and tissue damage is a potential threat.



Awkward postures

Safe exercises performed by arms must maintain a relatively close distance to the center of body mass without applying any twists or stretches to either the torso or the legs. This is crucial when considering what counts as awkward postures. It is an added risk factor on top of physical exertion. Tasks that demand some form of awkward posturing must be complemented with extensive muscle relief and recovery time. Some examples:

Performing tasks that involve long reaches

When performing long reaches frequently and it lasts more than a few seconds, the risk of harm significantly increases.

Working surfaces are too high or too low

This can be a result of that the working surface was not particularly designed for that specific activity or process.

Maintaining the same positions for an extensive period

Static postures increase the amount of force required to perform a specific task, in addition, contraction forces must be applied to maintain the body in a steady position throughout the activity.

Resonance and vibration

Constant exposure to vibrations such as tool kickbacks can result in similar symptoms to physical exertion. Muscle force is continuously applied to maintain a stable position by attempting to minimize the negative force generated by the vibration.

Inconvenient working environment



Static and loud noises

An average office environment sound level ranges between 50-60 dB. This is considered a tolerable level in comparison to working with heavy machinery, which may reach over 120 dB. Extensive exposure to such loud sounds may cause severe ear traumas if not managed in time the effect may come off as irreversible such as partial loss of hearing.



Poor visibility and lighting conditions

The outdoor light level is approximately 10000 lux on a clear day. In a building in the area closest to the windows, the light level may be reduced to approximately 1000 lux. In the middle area, it may be as low as 25 - 50 lux. To ensure peak performance, the lack of natural light within indoors must be compensated. The average optimal indoor light level ranges between 500 - 1000 lux - depending on activity. For precision and detailed works, the light level may even approach 1500 - 2000 lux. Lacking well-lit environments may lead to dizziness, nausea, migraine and potential cause of depression.



Temperature, Humidity, Air pressure

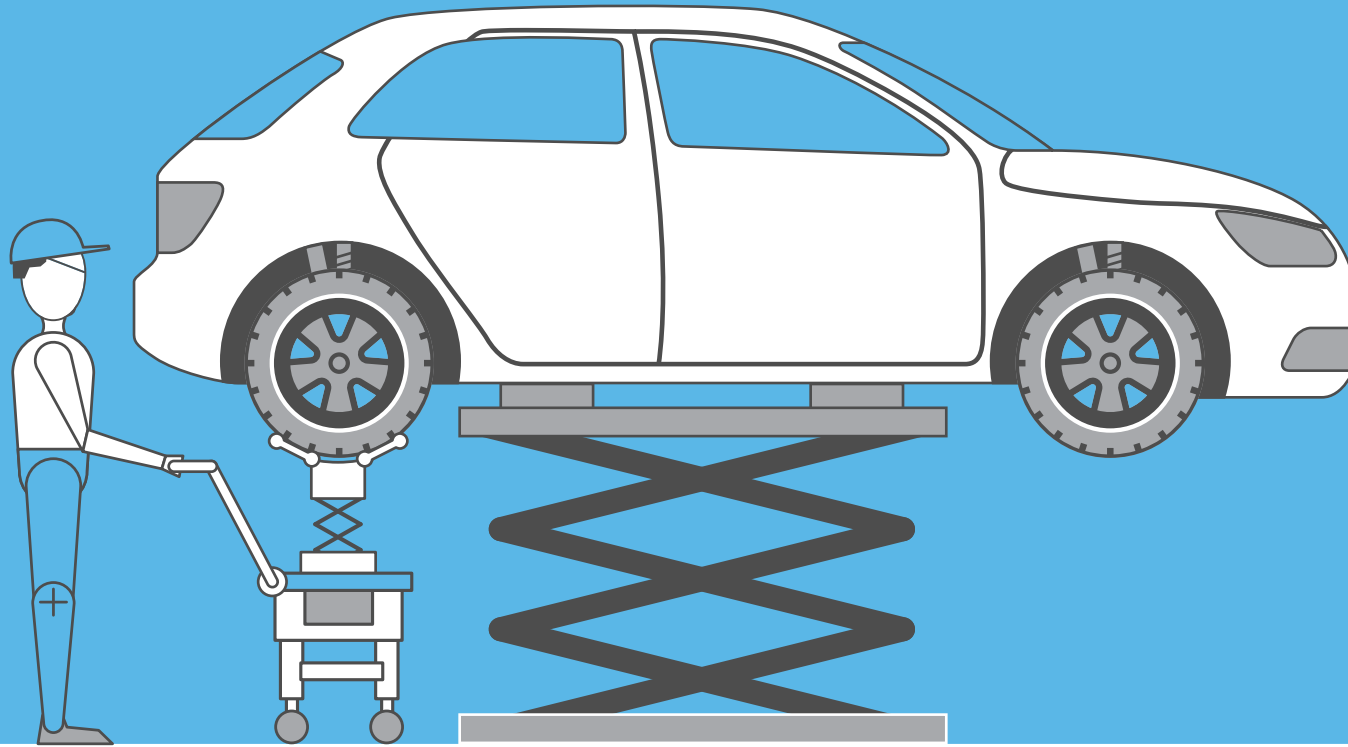
Indoor air temperature in summer may range from 25 to 28°C and 15 to 21°C in winter. Maximum air velocities vary from 0.15 to 0.30 m/s and air humidity are almost consistently 30% r.h.in winter and 70% r.h.in summer. Going over or below these limits may affect the workflow by causing nausea, inability to focus and the strong sense of cold or heat.

Inefficient workflow

Inefficient work breaks, irrational demand on production quantity and inefficient working methods all contribute to the deterioration of working quality.

Overloading the workers lead not only to physical, but also psychological encumbrance: stress levels continuously rise and hinder the workers' ability to concentrate on their tasks. This leads to sinking standards of quality and efficiency. The constant stress accumulates and leads to mental problems: anxiety, depression and lack of motivation, and may eventually lead to workers quitting the job.

An inefficient workflow can be attributed to a logistically illogical layout, inefficient structuring of work stages or lousy allocation of the workforce. These factors cause disorganization, ineffective use of work time, and crippled production. It also causes uneven distribution of physical or mental workload that may lead to either overload-spikes (which poses a risk of health damage) or idle phases (which hinders production efficiency).



MINIMIZING ERGONOMIC RISKS

Minimizing repetitive motions

Preplanning

Automation of extremely demanding processes can mitigate the probability of exhausting the workforce. The application of power and lifting tools will greatly reduce physical exertion and the necessity of awkward postures.



Policy and training

Establishing key procedures can help to reduce stress and the probability of accidents. Forbid great demanding performances and require obligatory recovery periods after extensive performances. Provide training sessions and courses to your employees on how certain operations and procedures should be performed and on how to minimize exposure to work hazards.



Workflow management

Rotation between tasks can also ensure that there is no constant repetition. This can also be used to minimize boredom as each worker will perform different activities during each work cycle.



Medical

Introduce mandatory health checks, optional massage courses, and physical education sessions to make sure that your workers are healthy and can perform well in the long run. Also, regular resting periods can support muscle recovery which can reduce the probability of injuries.



Minimizing physical exertion

Preplanning

The application of automation and the use of power tools can be a great help in minimizing exertion. Also, setting up a customizable work environment that allows each employee to adjust each machine to their preference can leverage the majority of risks that can result in exertion. Concerning heavy lifting, the inclusion of counterweights or heavy lifting tools is a great help as well.

Policy and training

Consider your employees as top-tier sportsmen. They require training on optimal heavy lifting and moving around heavy weights. Mandate regular training courses and establish a policy for each activity that may occur during work hours.

Workflow management

Minimizing repetition is the key. Ensure a variety of options for your employees for each day. Even just switching up processes or workers for a short period of time can make a difference.

Medical

Regular relief sessions and health checks in order to minimize muscle injuries and to address them early on.

Minimizing awkward postures



Preplanning

Recognize and terminate all unhealthy activities that demand awkward postures. This can be achieved first and foremost by monitoring workflows and processes. The second step is identifying all hazards. After we know all of the risks we can implement more optimal methods and if necessary some ergonomic or customizable tools or automate processes afterward.



Policy and training

Minimizing this time frame of awkward postures is crucial, but employees must be aware how to manage these periods when they do have to work in an awkward posture. Well defined work processes and procedures with a list of mandatory dos and don'ts can ensure that each employee is aware of every work hazard and able to cope with it.



Workflow management

Switching up processes to minimize the time each employee has to spend on performing the same task especially if it demands awkward positioning. Make sure to reduce the time each employee spends being exposed to such hazards.



Medical

Mandatory health checks and frequent relief sessions. Optional to require each employee to spend a set amount of time focusing on relaxing muscles after each demanding task.

Creating a pleasant working environment



Static and loud noises

If an employee is exposed to any sounds above 80dB for an extensive amount of time make sure to mandate the use of sound reducing equipment or separate their work environment from the source of the sound by introducing automated or remote controlled processes.



Poor visibility and lighting conditions

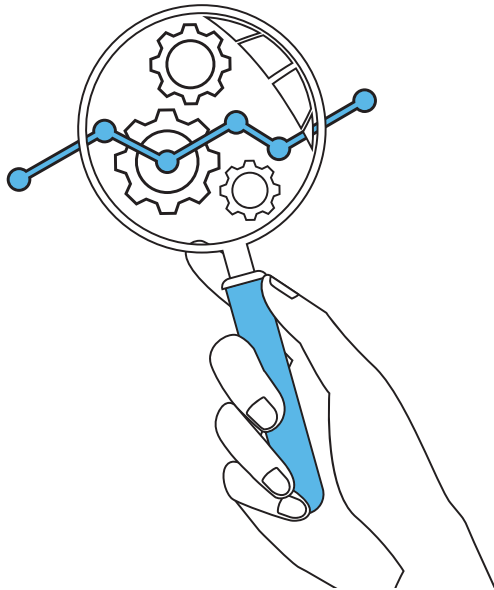
Ensure to maintain on average a 500-1000 lux volume of light level indoors or even higher if the activities require a high level of attention. Use as many natural lights as possible but also make sure to balance it out with the necessary amount of artificial lightning to reach the optimal lux volume.



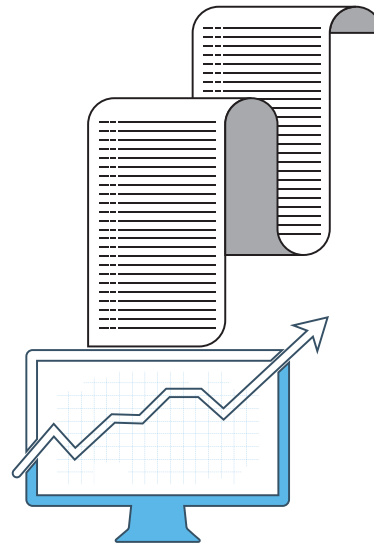
Temperature, Humidity, Air pressure

Make sure not to allow the temperature to fall under 16 Degree Celsius if the activity is physically demanding.

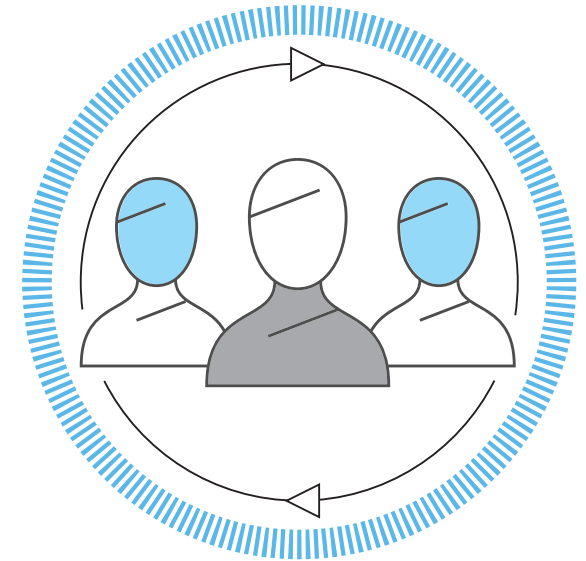
RECOGNIZING AND ATTENDING TO INJURIES AT AN EARLY STAGE



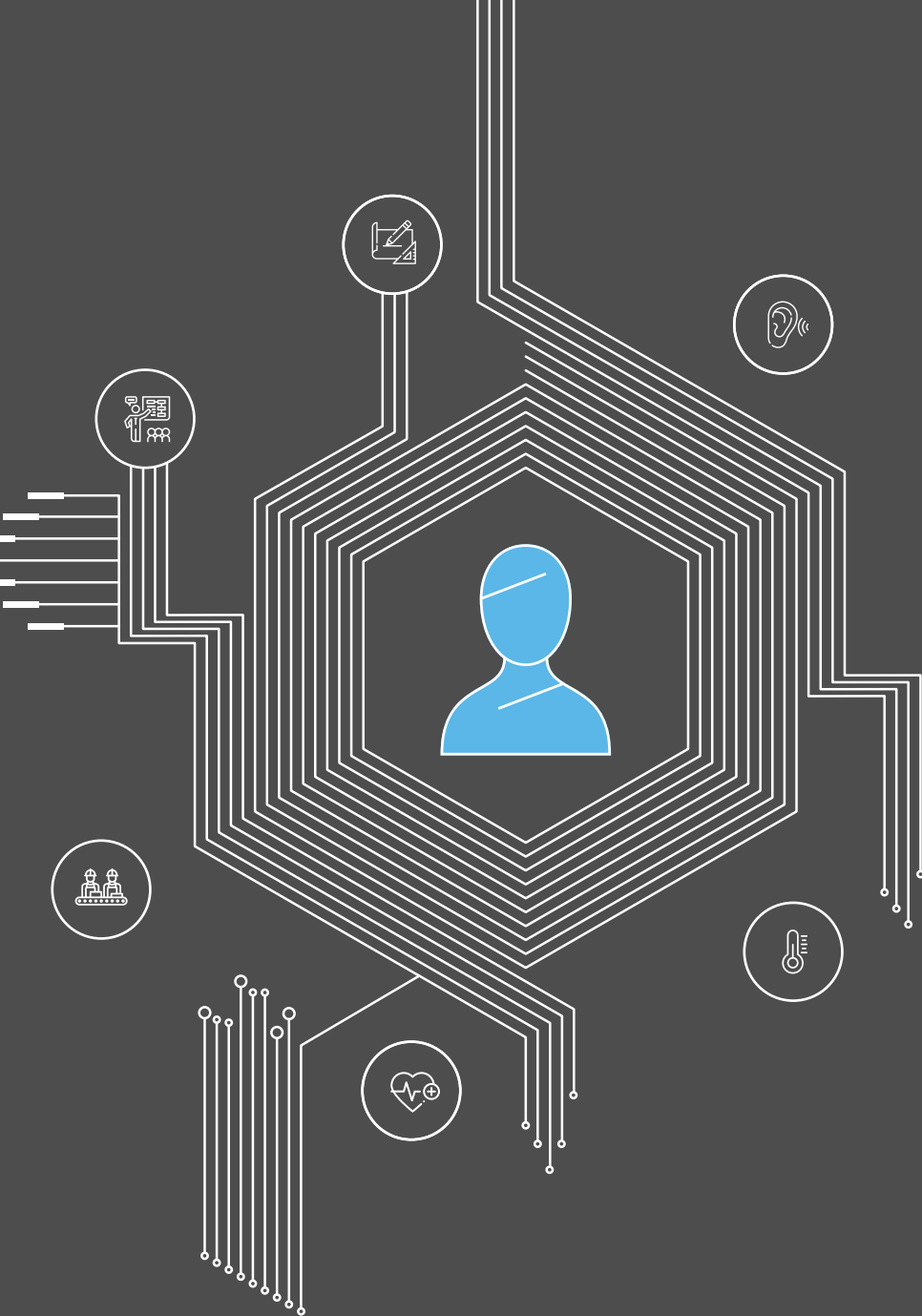
Starts with monitoring current workflows and identifying risks and hazards. This allows a better understanding of each employee's activities and the way they perform. From the get-go, this allows immediate intervention if extremely dangerous activities are noticed. The main goal is mitigating, terminating or prohibiting all unhealthy operations and activities on the employee side.



As a next step, it is recommended to put all things that were learned from the monitored activities into a well thought out and thorough policy for each and every activity an employee may encounter. Ensure that they are well aware of every potential risk and they are well equipped both in knowledge and with tools to prevent them from happening.



In case too much repetition or awkward motion is identified for a specific employee, give them the chance to temporarily rotate between activity cycles. This allows to minimize repetition and leave room for muscle recovery.



CONCLUSION

To ensure that your employees are in top condition and that they can perform their daily tasks without any negative effect, it is crucial to understand the way they operate: how they perform specific tasks and what risks they may encounter during them. Once all these risks are identified, one can take actions to make sure they are kept on a minimum level. This can be achieved by introducing alternative solutions that are less demanding for the employee or replaces their effort with automation.

It must be acknowledged that not all processes can be changed up so that they won't pose any sort of risks anymore. But you can make sure that your employees are fully aware of such risks and they have all necessary knowledge and abilities to perform those tasks in a safe manner. In exchange make sure that after any demanding process employees are given with the required amount of time to rest and be prepared for the next cycle. To ensure the well-being of workers make sure they undergo mandatory health checks on regular basis and if any risk for injury is identified, they are addressed in time.

The well-being of the employees is for the betterment of the organization. By making the workplace as safe as possible, it is guaranteed that the performance and work quality will also thrive.



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