Ergonomics Research Techniques

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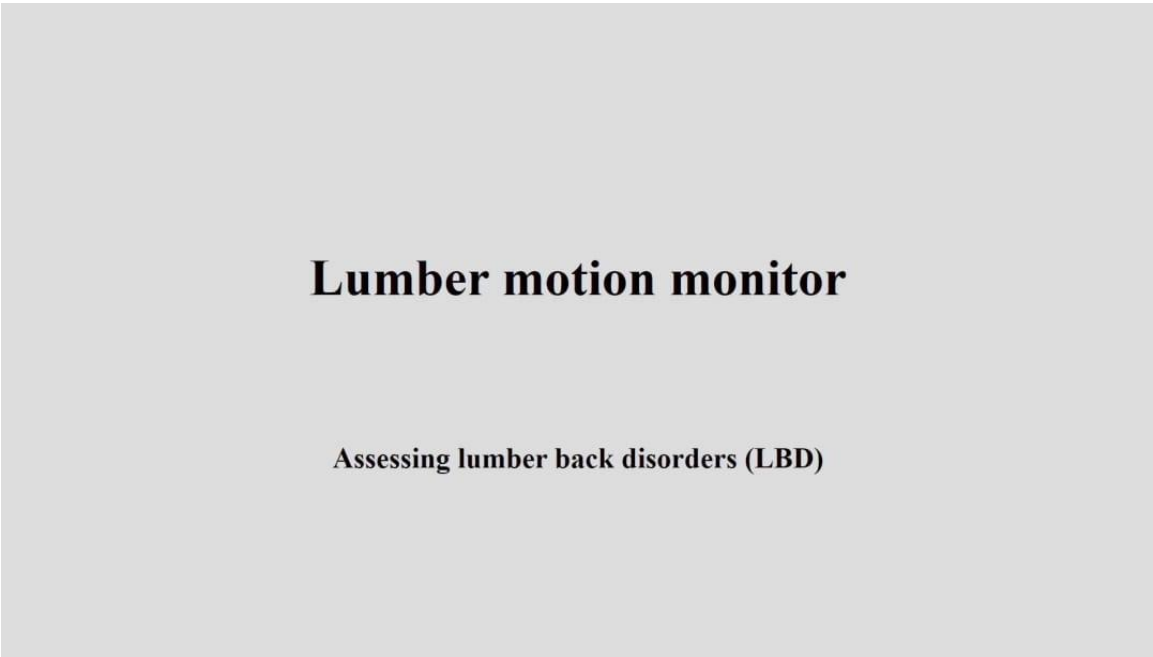
Week – 05

Lecture - 17

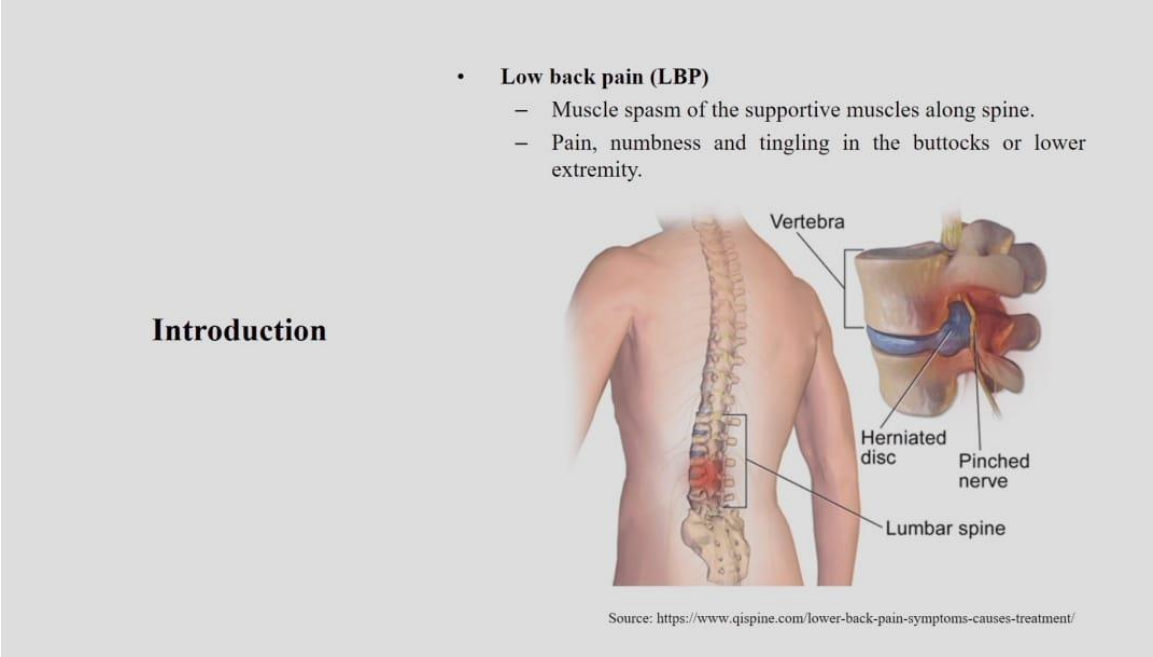
Lec 17: Lumber motion monitor (LMM)



Next, we are going to talk about Lumbar Motion Measurement. This particular table Snooks table is basically from the pre-computed table. Whereas, Lumbar Motion Monitor or Lumbar Motion Measurement that LMM is an instrument and using that instrument we are going to understand the trunk kinetics and how it is happening in the work setup. So, it is going to talk about the Lumbar Back Disorder or whole back, but mainly concentrating on the lumbar region. So, that is why it is Lumbar Motion Monitor LMM. It is a very costly instrument.

However, we at DOD lab we do not have, but many of the students use this particular instrument at other place, and from there we gathered data sometime and also from the different publication. So, whatever I am talking about this particular instrument, this instrument is not available right now with us, but we have gathered all information from various publication. So, first, let us understand for this particular instrument what is the

definition of low back pain. Because based on the definition of low back pain identification of risk or talking about the risk keeps on changing.

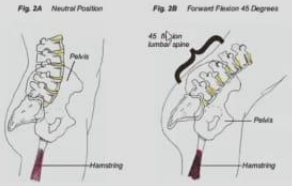


So, for this particular instrument, low back pain is defined as the muscle spasm of the supportive muscles along with the spine. So, pain, numbness, and tingling in the buttocks or lower extremity. So, very specifically it is talk it talks about the lower back ok only lumbar region not the other part, not the coccygeal or not the not the upper upper back. It is only talking about the lower back region. So, you can see from this photo like picture it is referred the source is given over here, it is nothing that we collected the photograph.

So, how this particular region is going to give you the pain sensation.

Introduction

- Globally 2/3rd of adults experience LBP
- It is mostly seen in
- Frequently use back muscles
- Major risk factors- **Periodic lumber flexion** and **rotation**
- Assessed in terms of accumulated lumber motion and loads



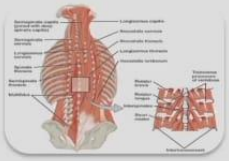
Source: https://dubinchiro.com/2013/10/low-back-pain/

So, why do we need all this? So, you know what is happening the data says maybe 20 two-thirds of the adult in whole population experience low back pain. And it is seen that most of the work occupation bank workers, health care workers, person who is working in the laboratory, people of the IT sector, banking sector most of them are having low back pain. How low back pain? If the person is sitting for longer period, so sedentary sitting job also can cause low back pain, or excessive movement of low back also can cause low back pain. So, low back pain the causal factors of low back pain is variety in nature ok varied in nature.

So, it is very difficult to pinpoint that these are the only causal factor which is causing the low back pain. So, frequently used back muscles they are going to cause your low back pain. Major risk factors are periodic lumbar flexion and rotation. So, assessed in terms of accumulated lumbar motion and load through this particular instrument.

Introduction

- Common causes of LBP:

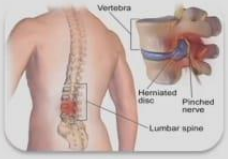


Muscle strain

Ligament sprain

Poor posture

Age



Disc bulge

And these are the identified causal factor, but these are not only the case there are some more.

Lumber motion monitor (LMM)

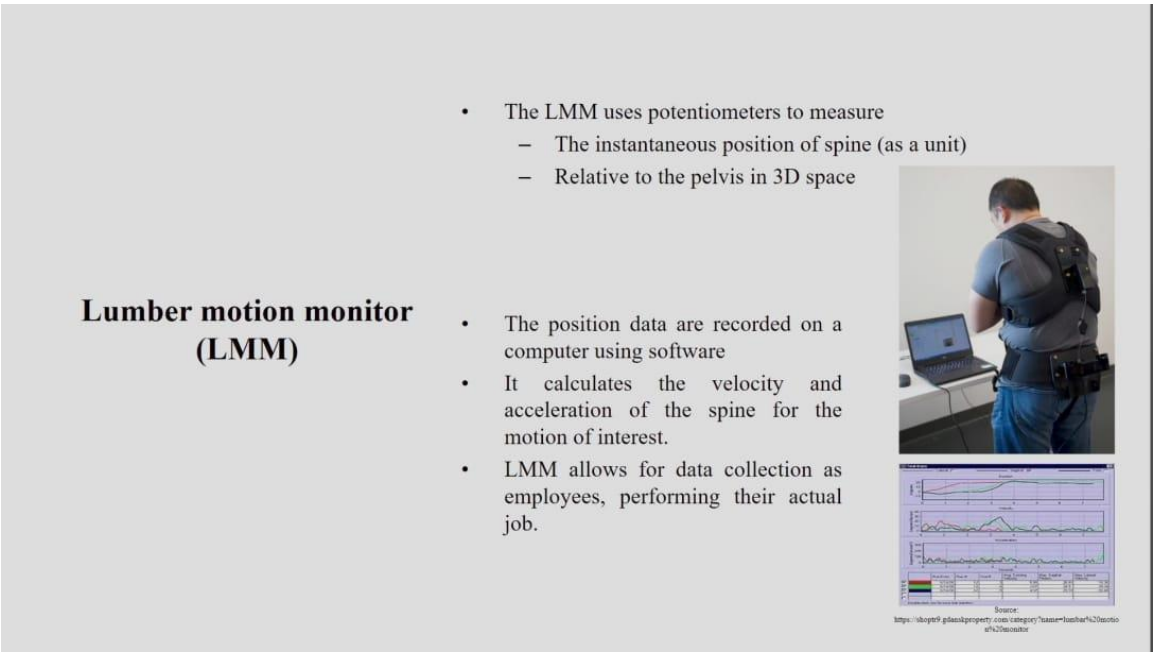
- A technique to assess the dynamic components of LBP risk in various occupational fields.
- Flexible and stretchable strain sensor.
- A triaxial electrogoniometer.
- Acts as lightweight exoskeleton of the lumber spine

- Placed on the back of an individual, directly in the line with spine.
- Attached using harnesses around the pelvis and over the shoulders.

Source:
https://shopt9.gdanskproperty.com/category?name=lumbar%20motion%20monitor

Now, coming to this particular instrument that is the lumbar motion monitor. This looks like this look like this. It is kind of an exo-skeleton, it has some component over here and the whole system is connected through this type of back strap. So, a technique to assess the dynamic component of low back risk. So, whenever we are talking about low back pain and we are trying to understand the risk, so maybe posture, maybe force, maybe bending position those are all static in nature.

But this LMM is going to give you the dynamic component of various occupational field. So, flexible and stretchable strain sensor, so these portion is having the sensor it is stretchable and flexible. A triaxial electrogoniometer is present, it is inside acts as lightweight exoskeleton of the lumbar spine. Placed on the back of an individual directly in the line of the spine, so you have a spine, so it need to be placed along with that. Attached using harness around the pelvis and over the shoulder you can see. So, with the harness, it is being attached to the body.

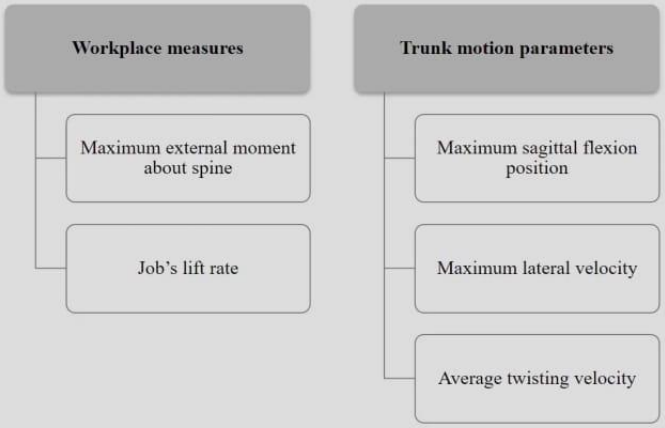


So, that LMM uses a potentiometer, so that is the basic working principle that it uses potentiometer to measure the instantaneous position of spine and relative to the pelvis in 3D space. The position data are recorded on a computer using the software. Of course, it is software-based, so it has an hardware component and it has a software component. So, you can you need to install that into the in your laptop and you need to record that.

It calculates the velocity and acceleration of the spine for the motion of interest. So, which motion you are going to record. So, that for that particular motion acceleration and velocity will be measured. LMM also allows for data collection as employees performing their actual job. So, this is very important on field data collection in actual data collection. So, real-time data collection is possible with LMM.

Lumber motion monitor (LMM)

- Five factors together determine the probable risk to a job-

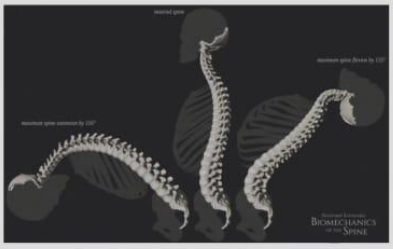


Now, 5 factors together determine for using this LMM, 5 factors actually going to determine the probabilities to a job. 2 are from workplace measure and 3 are from trunk motion parameter. So, workplace measure under that we have maximum external moment about that particular spine and jobs lift rate, what is the lifting rate. For the trunk motion you have maximum sagittal flexion position in a sagittal plane, what is the maximum flexion is happening? Maximum lateral velocity, average twisting velocity.

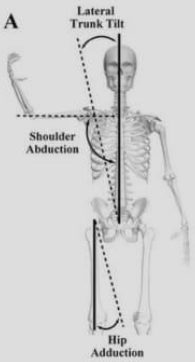
So, these are the 5 factors or you are going to determine using the LMM.

Lumber motion monitor (LMM)

- Workplace measures-
  - Maximum external moment about spine/ Maximum bending moment
  - Job's lift rate
- Trunk motion parameters
  - Maximum sagittal flexion position
  - Maximum lateral velocity
  - Average twisting velocity



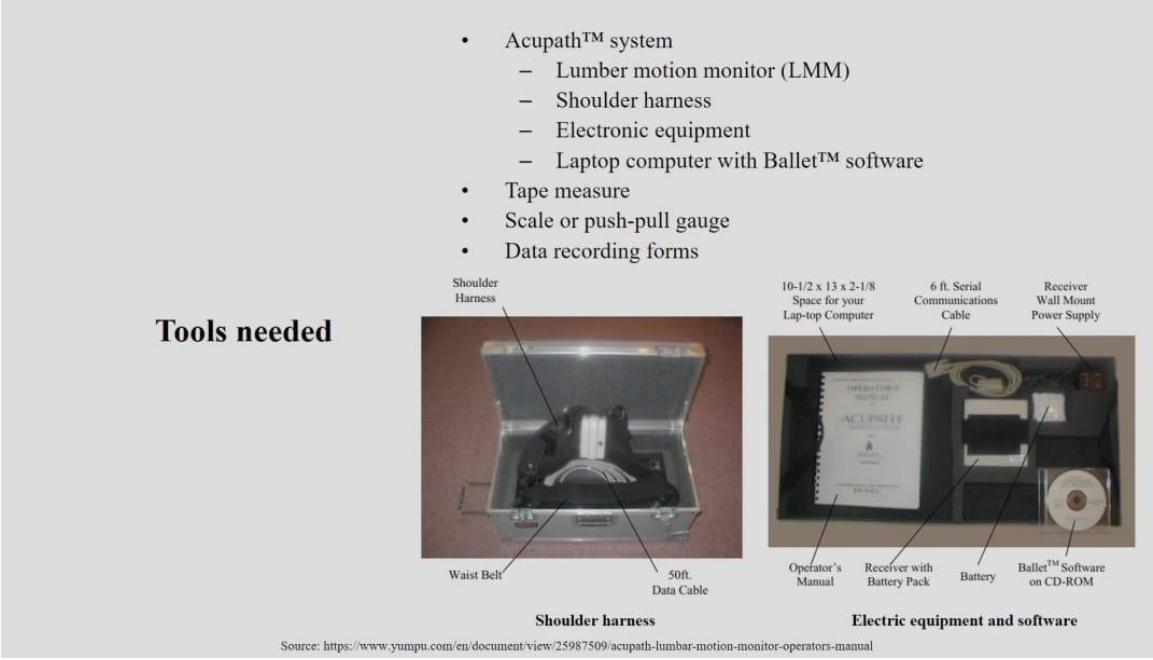
Sagittal flexion & extension position



Lateral trunk tilt

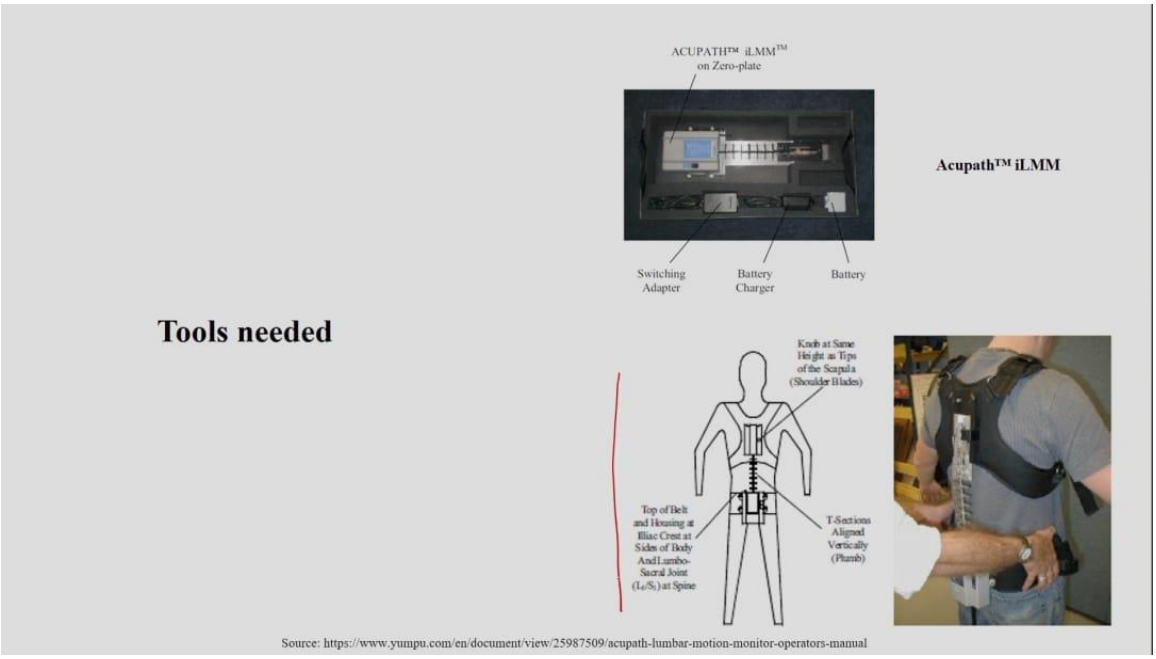
So, under this workplace measurement what you are going to do? Maximum external moment about the spine or maximum bending moment, maximum bending moment that you are going to get, and jobs lift rate. So, trunk motion under that you are going to get maximum sagittal flexion I explained it earlier, lateral velocity and twisting velocity. So, what is the twisting has happening, what is lateral bending is happening, what is flexion is happening. So, this movement, this movement, and this movement of your lumbar region.

So, these are the things you are going to get for the trunk motion. So, in you can imagine when you are doing a job in an industrial condition, what are the varieties of trunk movement is possible. Either you bend and do the job, either you twist your trunk in either side and do the job or you bend this way or this way and do the jobs. So, these are only 3 motions that you are going to get using this particular instrument.



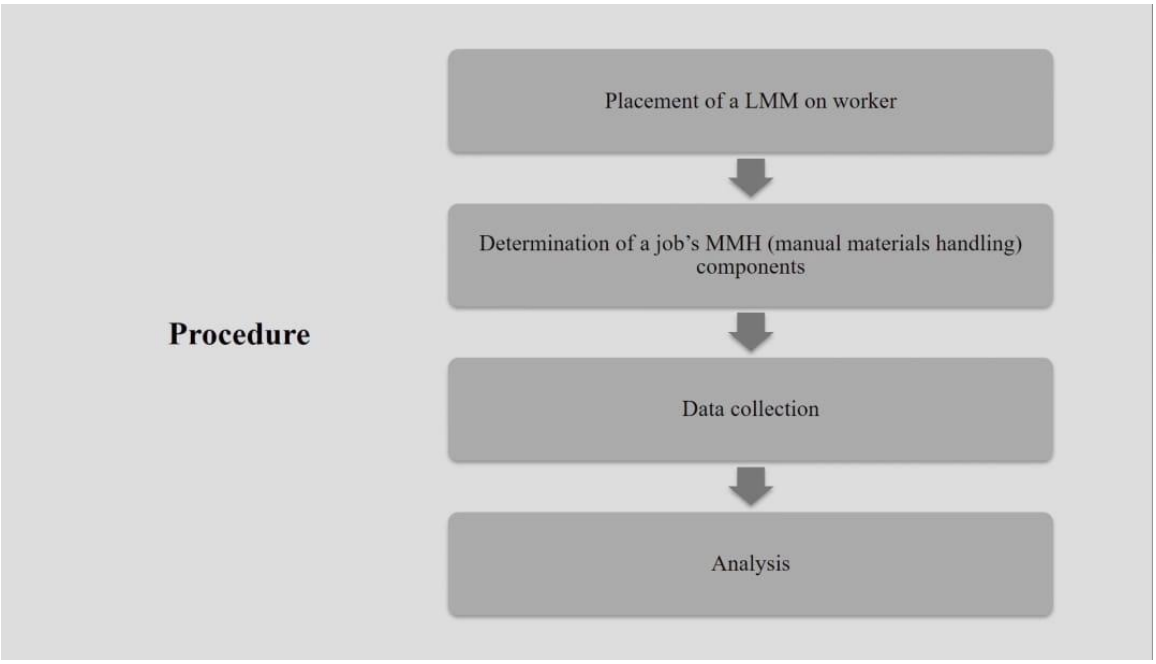
Now let us understand how this whole instrument look like as I mentioned we at DOD do not have this particular instrument.

Whatever photographs you can see over here it is sourced from this particular manual so, lumbar motion monitor you will have, you will have shoulder harness, you will have electronic small equipment, laptop computer with a particular software which is going to help you in the analysis. Also, you will have tape measure, scale or push-pull gauze, and data recording form because in a particular form you have to record the data and this is how these things will look like. As we do not have we will not be able to show you the actual experiment.



Now you can see how this figure is how you need to fit it. So, with the shoulder harness and buttock harness you need to fit.

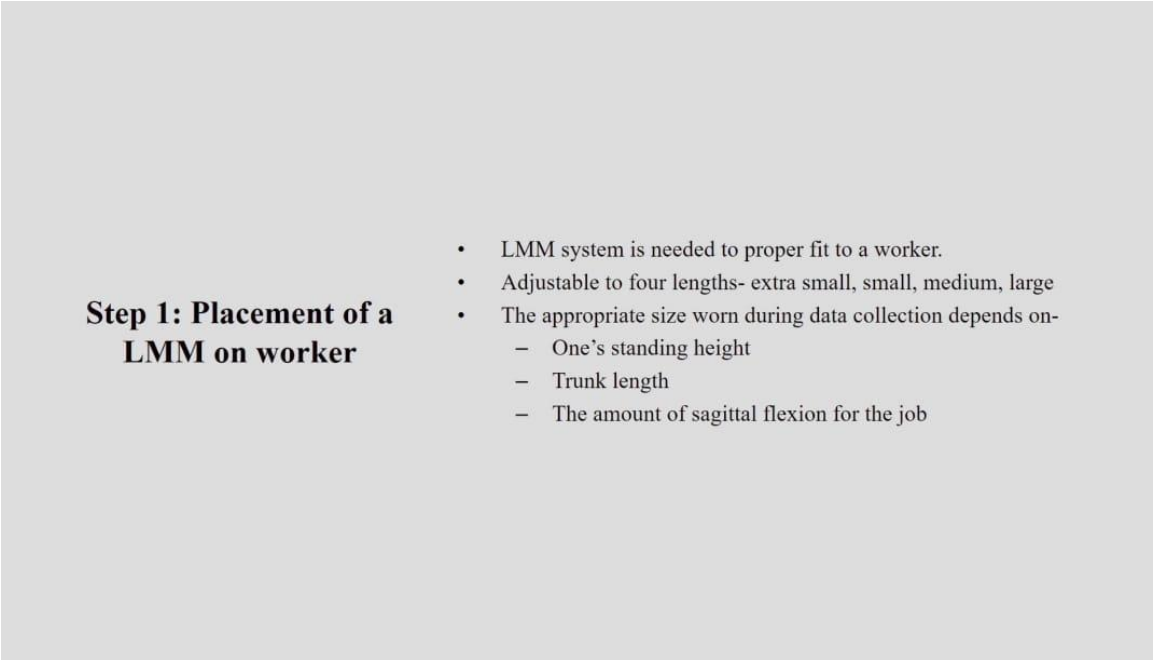
So, this is the sensor and this is the kind of goniometer you have, and this how it will look. So, in original this is a figure and this is in original how it will look like when you will set up the instrument on the operators back.



So, procedure first what you have to do? You have to place the LMM on that particular worker. You have to determine a particular job which you are going to analyze this

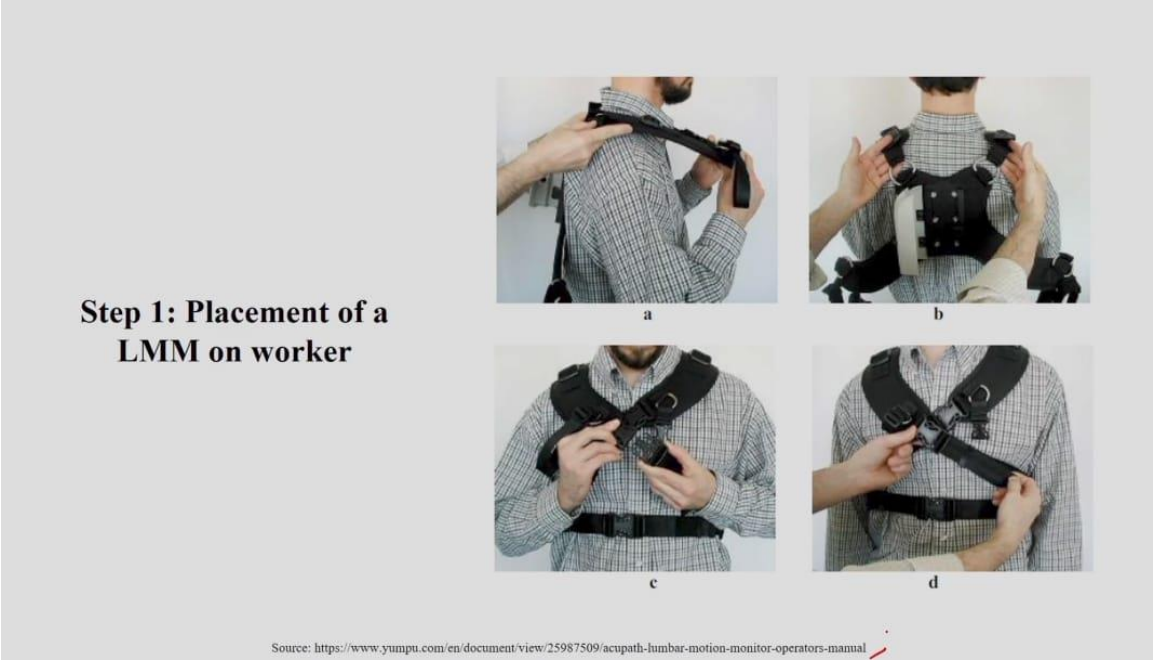
manual metering handle that particular component. You have to do the start the data collection.

Once data is being collected you have to analyze this. Now analysis mostly is done by the software. However, based on your objective you can choose which component to be taken. It may give us many numbers of variables or you know many data points. However, it is you that you are going to decide which to take which not to take for your further analysis.

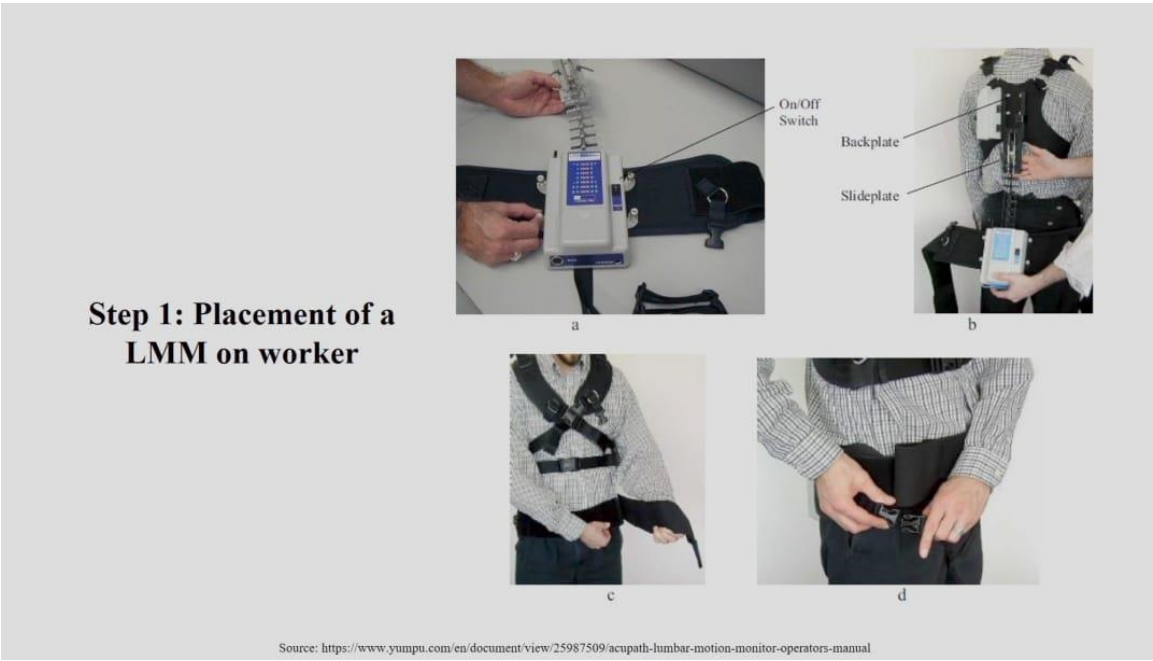


So, placement some specific important thing need to be considered while placing the belt and the sensor on the back. LMM system is needed to fit properly on the worker. So, you have adjustable four lengths extra small, small, medium, and large because you depending on your body size. The appropriate size you need to own during the data collection. Once standing height, trunk length, and the amount of sagittal flexion for a particular job.

Based on that you will be wearing that particular sized thing. That strap need to be adjusted accordingly.



So, you can see how do you adjust it. As I again I would like to mention all these photographs are sourced from here as we do not have the instrument, I will not be able to show you the actual instrument and how do we do use it in the laboratory. So, that is not available that is why I have taken all these photograph from the manual so, this is how you are going to adjust very easy you know easy to place it.



So, this is how it looks like. So, you can see them that how the black beltyou need to slide through and how to switch on it and all those things.

Step 2: Determination of a job's MMH components

- Correctly identify all job elements that have the potential to produce injury-
  - Lifting
  - Lowering
  - Pushing
  - Pulling
  - Carrying
- The software used for data collection allows for 8 tasks to be defined.

Moving to the next part that determination of the job correctly identify all job elements that have the potential to produce injury while lifting, lowering, pushing, pulling, and carrying. So, these are the same or similar component that we discussed in the Snooks table. The software used for data collection allows for 8 tasks to be defined.

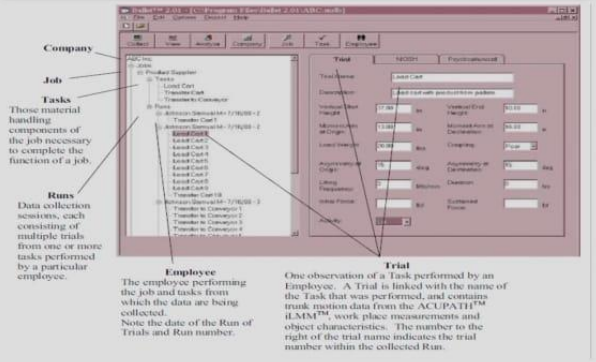
So, at one time 8 separate task you can choose for your data collection. So, how the data collection will happen?

Step 3: Data collection

- The software prompts users to structure job in a hierarchical manner.

Define the job, tasks and employees

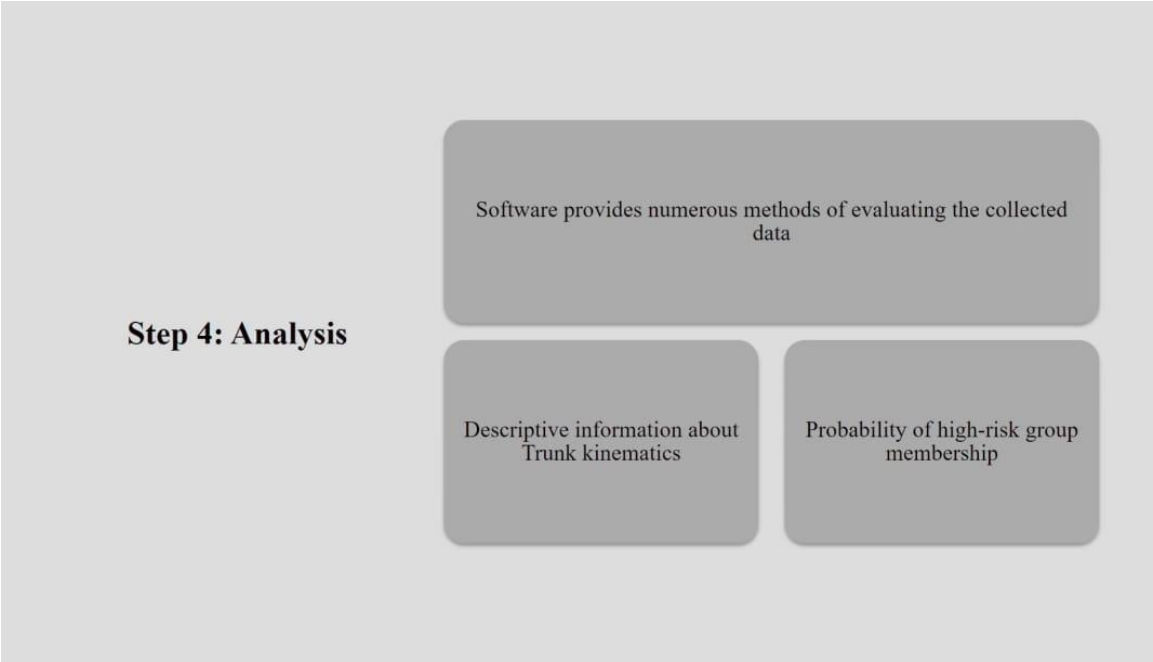
Input the all data and additional data into software



Source: https://www.yumpu.com/en/document/view/25987509/acupath-lumbar-motion-monitor-operators-manual

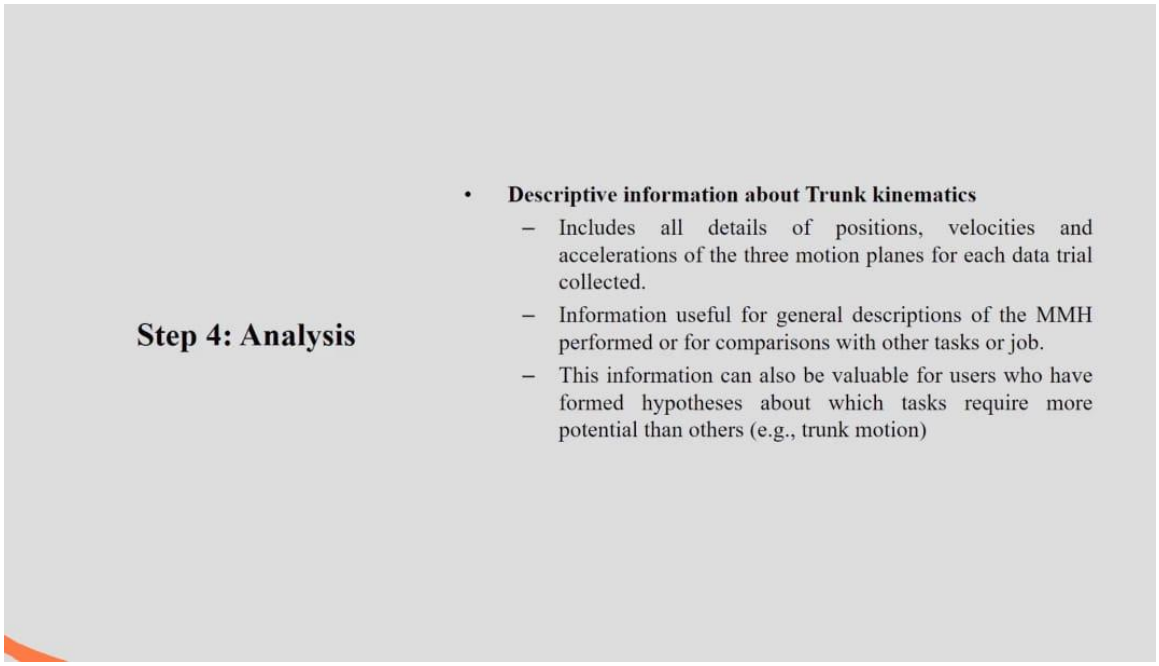
It is going to happen through theno online transmission and the software will have the data as again I would like to mention it is not available. So, everything is the screenshot from this particular manual. The software prompts users to structure job in a hierarchical manner. So, what is happening? Define the job, task, and employees and input the all data and the additional data into the software.

So, you are going to give all these information in these places and you will get the results after that once you start the data collection.



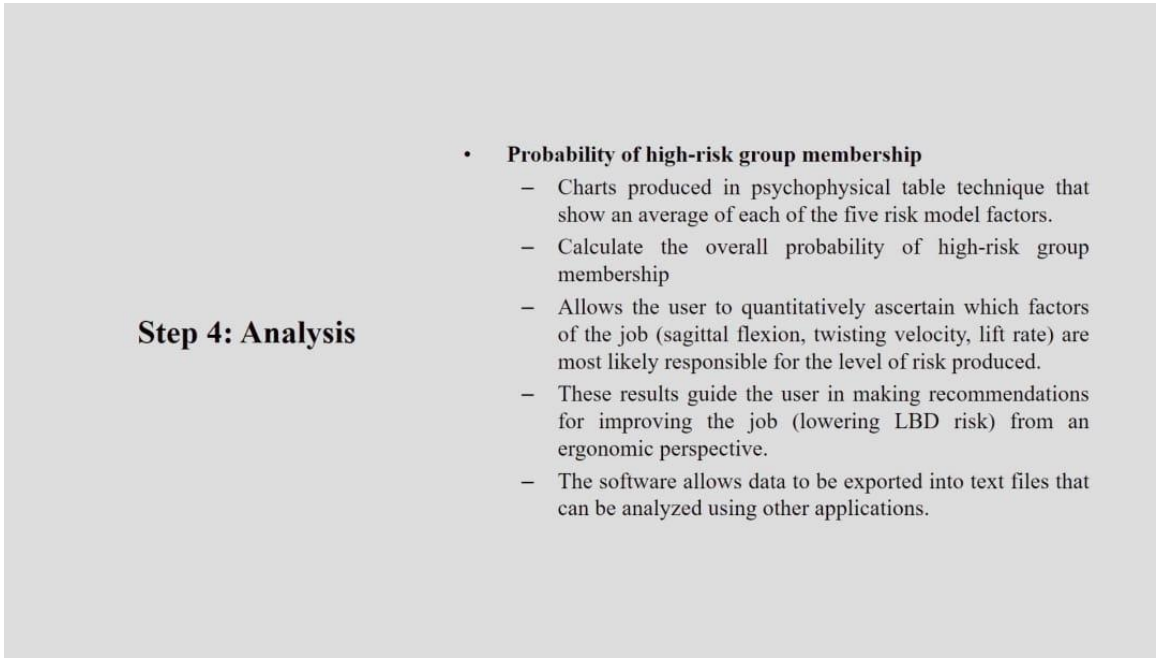
So, software or analysis what will have? It will have major two component. One is the descriptive information about the trunk kinematics. So, what is happening? So, all descriptive description and then probability of high-risk group membership. So, you have a group of people and to whom you are going to collect from whom you are going to collect data and it is going to give you this information.

So, two major chunk there will be many subdivisions you have to choose which one need to be taken for your experiment. So, it is not that you have to take everything based on your objective you can select your set of data.



So, for descriptive information it includes all the details of positions, velocities, acceleration of the three planes for each data trial collected. So, for each data, you have all these information that is why I said lot of data points. So, information useful for general description of the MMH performed or for comparison with other task or job.

This information can also be valuable for users who have formed hypothesis about which task require more potential than any others ok that is done for the descriptive information about the trunk kinematics.



And for probability of high-risk group membership, these are the points you are going to get. So, heart what else see the charts that is going to produce in psychophysical table technique. So, it has all these psychophysical table technique that show an average of each of the five risk model factors. It calculates the overall probability of high-risk group membership.

So, who are going to get more difficulties. So, it will group them ok according to the data. Allow the user to quantitatively ascertain which factors of the job is it sagittal flexion, is it twisting, twisting velocity or is it the lifted or anything else which one are most likely responsible for the level of risk produced while doing this particular job. So, that is very important information that you are going to get. So, this component of the analysis is very very important.

These results guide the user in making recommendation for improving the job from an ergonomic perspective. The software also allows data to be exported into text file that can be analyzed during any other application. So, this is how you are going to get data, you are going to analyze it and you can export them as per your requirement.

Advantages

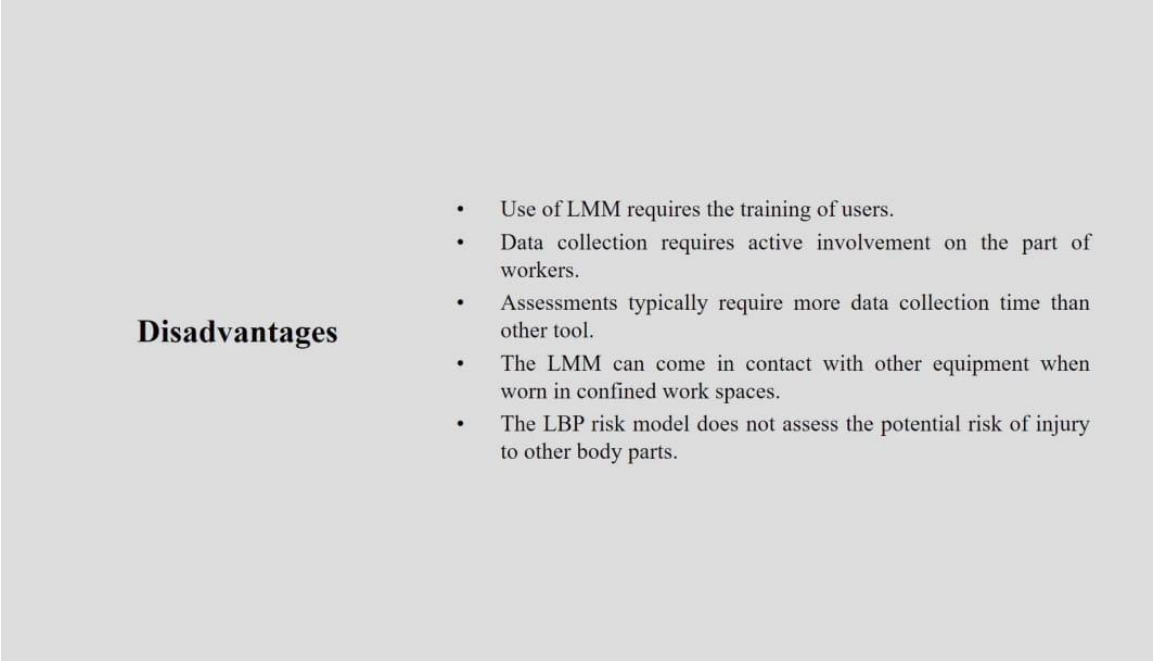
- Data gathered using the LMM are quantitative.
- It allows 3D trunk kinematics to be collected in real-world environment.
- The LBP risk model determines the extent to which the level of a particular risk factor, or the overall LBP risk level itself.
- Risk levels are compared with a database of actual workplace factors and trunk motions previously found to have high and low LBP rates.
- The impact of job interventions can be assessed quickly.
- The risk model has been validated.

Let us understand the advantages and disadvantages of this particular instrument. Data gathered using LMM are very quantitative in nature.

So, you have lot of numerical values and you have lot of scope to do varieties of statistical analysis using this type of data. It allows 3D trunk kinematics to be collected in real-world LMM. This is very important that you know whatever you are doing you know maybe it is not from the real-time, but using this instrument you put the instrument on the operator and ask him or her to do the job and you are getting exact value, exact

data what is happening in actual. So, this is amazing data set that you are going to get if you are using this instrument. So, the LBP risk model determines the extent to which the level of particular risk factors \or the overall LBP risk level itself.

Risk levels are compared with a data set of actual workplace factors and trunk motion previously found to have high and low low back pain rates. The impact of job interventions can be assessed quickly and the risk model has been validated before you are using. So, you can use this particular instrument for any such case and you can get lot of data and you can do lot of intervention after your analysis.

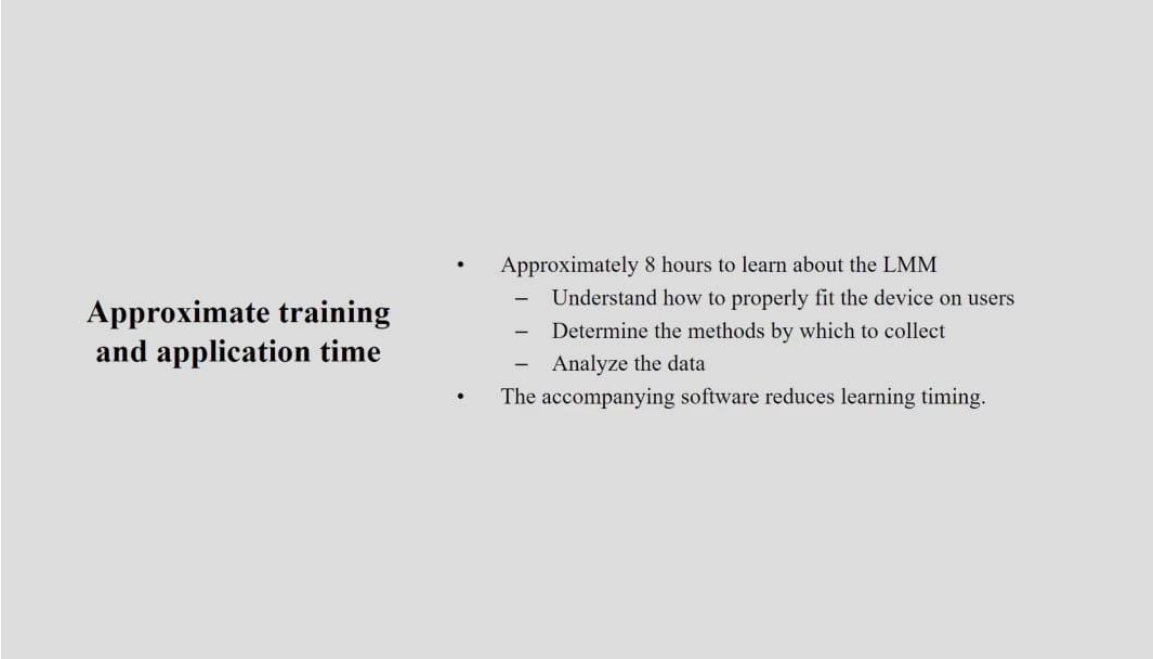


But there are some disadvantages for every tool there will be some advantages, there will be some disadvantages. Based on your objective you have to choose that which one is useful for you, which one is not useful for you.

So, use of LMM requires training you can understand it is a complicated instrument, it needs understanding of the software, it needs understanding about the hardware, it needs understanding how do you integrate them. So, it needs lot of training. Data collection requires active involvement on the part of the workers if someone is not ready to accept that I will wear this exoskeleton and work you will not get the data. So, subject participation is very important. Assessment typically requires more data collection time than any other tool because you have lot of setup then no actual data and all those things.

So, LMM can come in contact with other equipment when own in no confined workspace. So, then maybe it is disturbing or maybe you know problematic for the workers. The low back risk low back pain risk model does not assess the potential risk of

injury to other body parts. It only talks about lumbar portion of your back. So, these are the disadvantages.



Approximate timing. So, approximately 8 hours you need to learn this LMM, but it absolutely depend that what is your level of understanding it can be varied. Understand how to properly fit the device on users. Determine the methods by which to collect it and analysis of the data. The accompanying software reduces the learning time, but understanding that software also is an important aspect.

So, in total if you look at this particular instrument it is little complicated you really need some basic understanding of lumbar movement and all those things then only you can use this particular instrument. So, that is all about the lumbar motion monitor. So, I again would like to mention here that this instrument is not with us right now at our laboratory. So, I will not be able to show any kind of experiment whatever data or whatever picture or information I have shown here all are from the manual. That is all for today. Thank you.