Ergonomics Research Techniques

Urmi Ravindra Salve

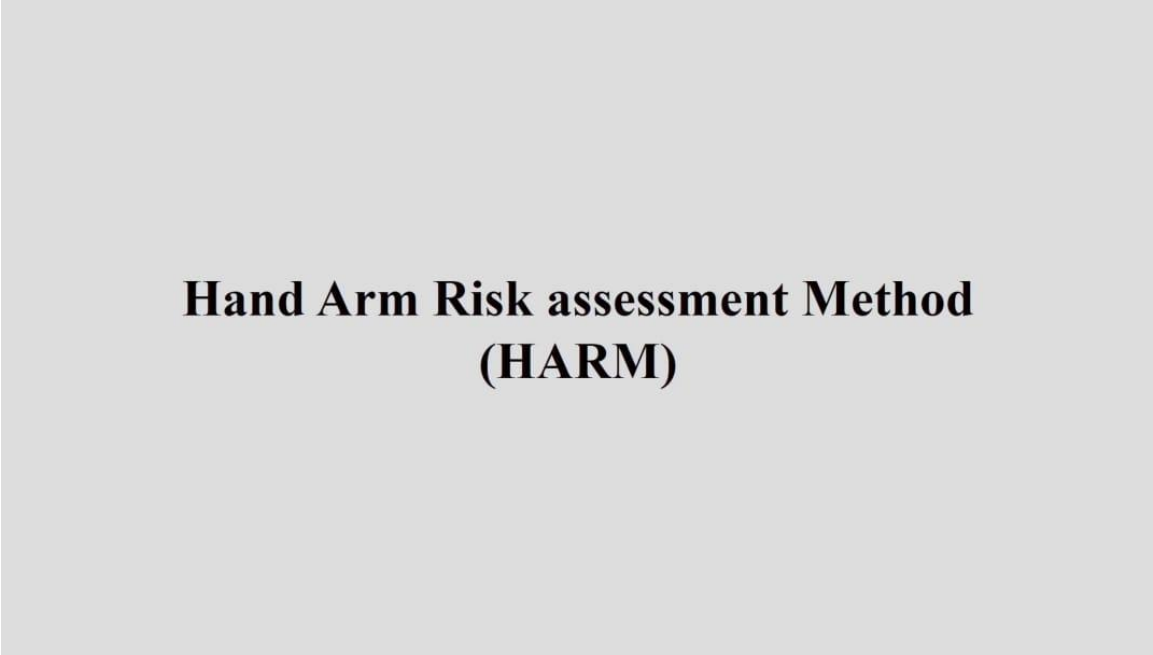
Department of Design

Indian Institute of Technology (IIT) Guwahati

Week – 05

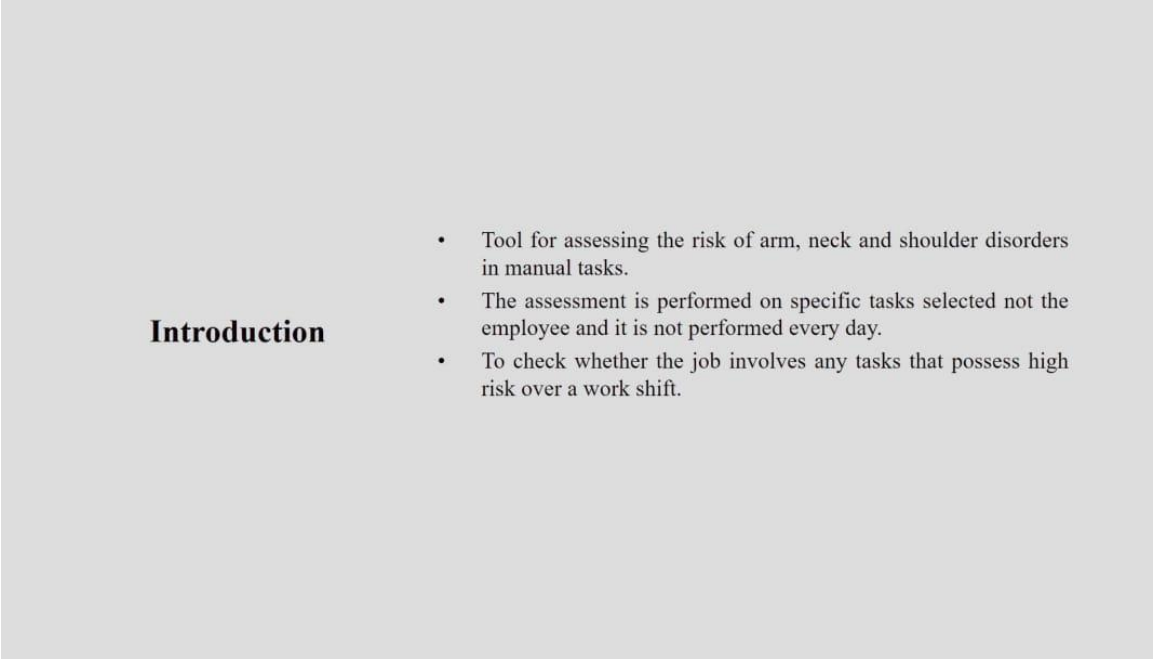
Lecture - 19

Lec 19: Hand Arm Risk assessment Method (HARM)



Welcome back. Today we will talk about one new tool which is related to again only for arm, neck, and this particular region. So, the name of this tool is hand-arm risk assessment method. So, you can understand from the nomenclature that it is mostly related with arm. However, arm is connected to your neck, shoulder. So, we will be talking about those body parts as well.

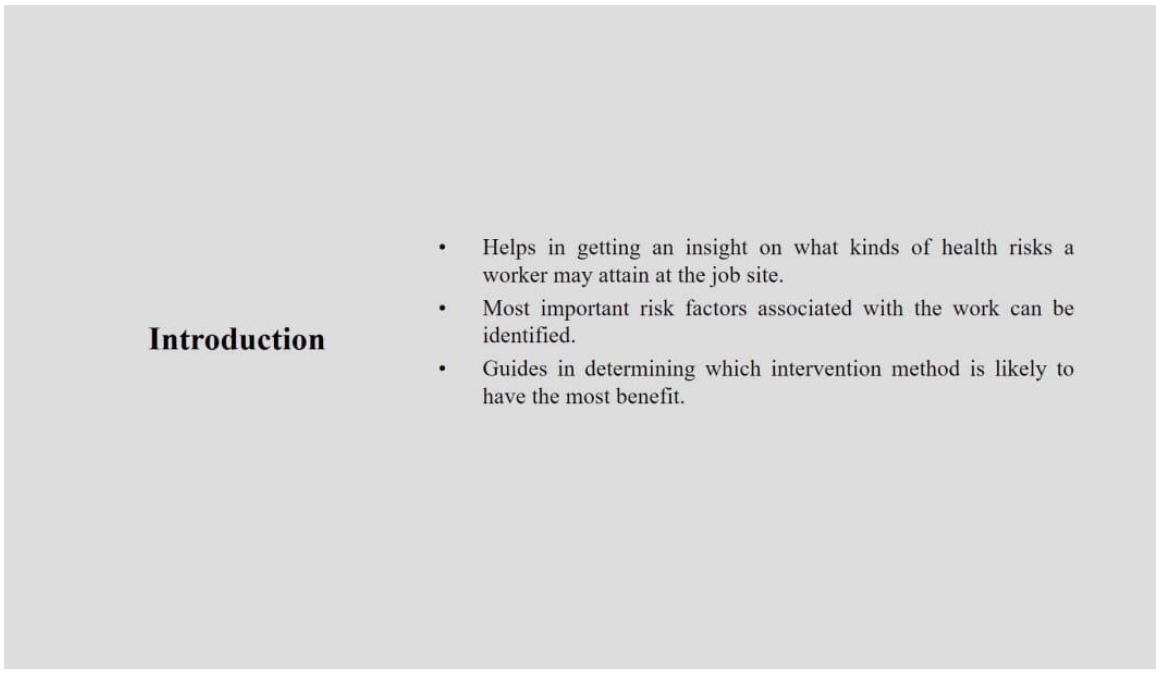
Similar to OCRA, it is mainly related to the distal upper extremity, mainly the upper extremity so, this particular tool again used where you have some kind of force exertion along with some repetitive movement with your hand and arm. So, let us understand the introduction part and we will go for the procedure.



So, this tool is for assessing the risk of arm, neck, and shoulder. So, you understand neck, shoulder, and your arm.

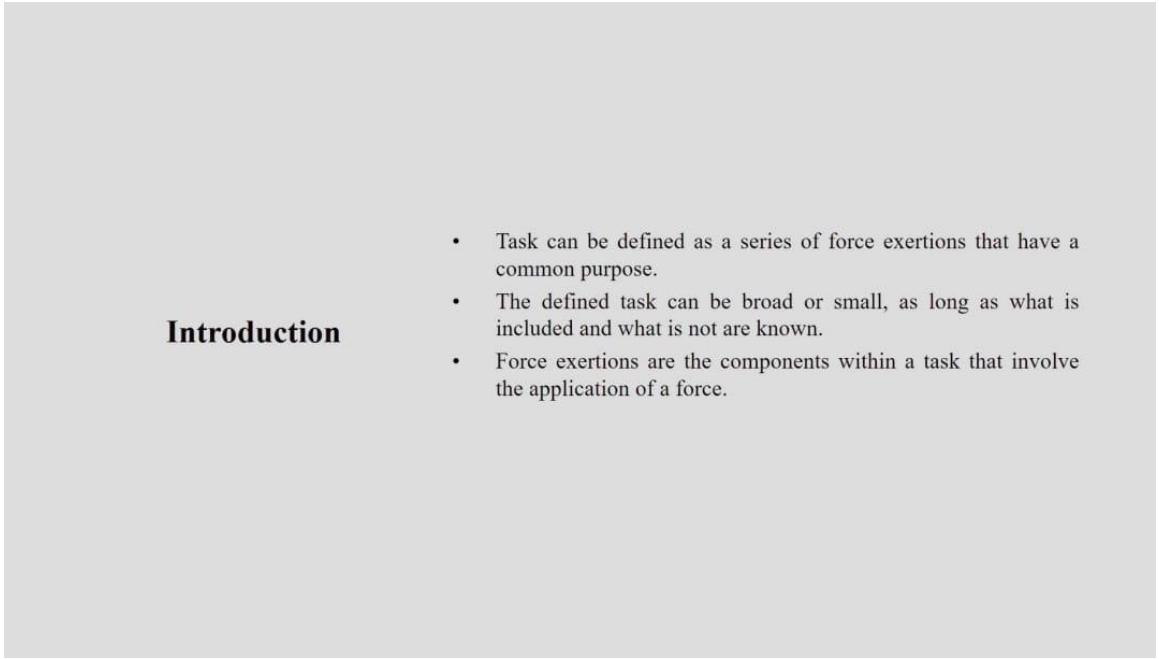
So, you know normally what happens due to industrial revolution, most of us like the worker who is working at the work different workplaces, we are sitting in a particular condition may be sit-stand workstation or complete sitting workstation, but we are involved in a particular job where mostly our upper extremities upper body is involved. So, we are not moving a lot. So, that is why there are lot of development happened and these are the regions specifically you know neck, shoulder, and of course, when you are sitting back ok trunk. So, these are the major group of muscles we are which are going to get exposed towards different risk factors of musculoskeletal disorder. So, there are lot many tools available which is talking about upper extremity.

So, this tool is also very specific to the upper extremity neck, arm, and shoulder and of course, this is very specific when the operator is involved for any manual task. So, the assessment is performed on a specific task selected not the employee, and it is not performed every day. To check whether the job involves any task that process high risk over a work shift. So, when we are talking about the whole task the all the task that we are going to consider what is the condition, what is the situation or status of that task that particular task in the whole job or whole work shift that we are going to understand through this.



This particular tool HARM, HARM helps in getting an insight on what kinds of health risks a worker may attain at the job site.

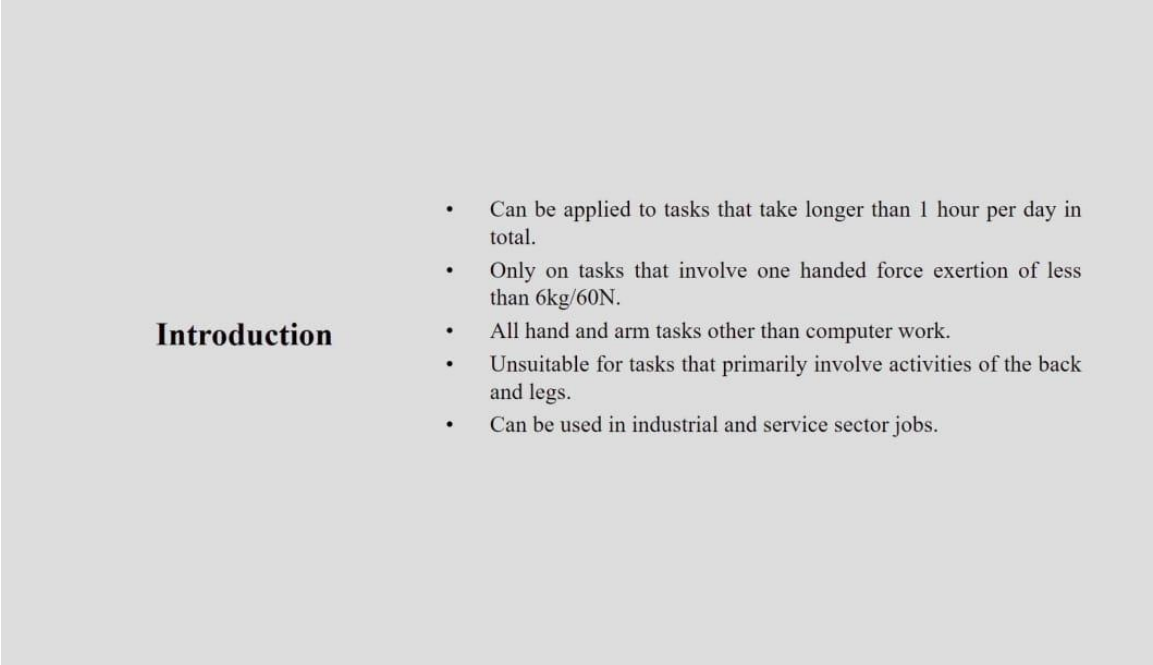
Most importantly risk factors which is associated with the work can be identified with this particular tool and you can develop a guides in determining which intervention method is likely to have the most benefit. So, it gives a direction that which type of intervention may help the situation at the maximum level. So, optimizing between the intervention point and the work situation that can be done using this particular tool.



So, the task can be defined as a series of force exertion that have a common purpose. So, there is a goal of doing some task and there are some kind of force exertion to do so.

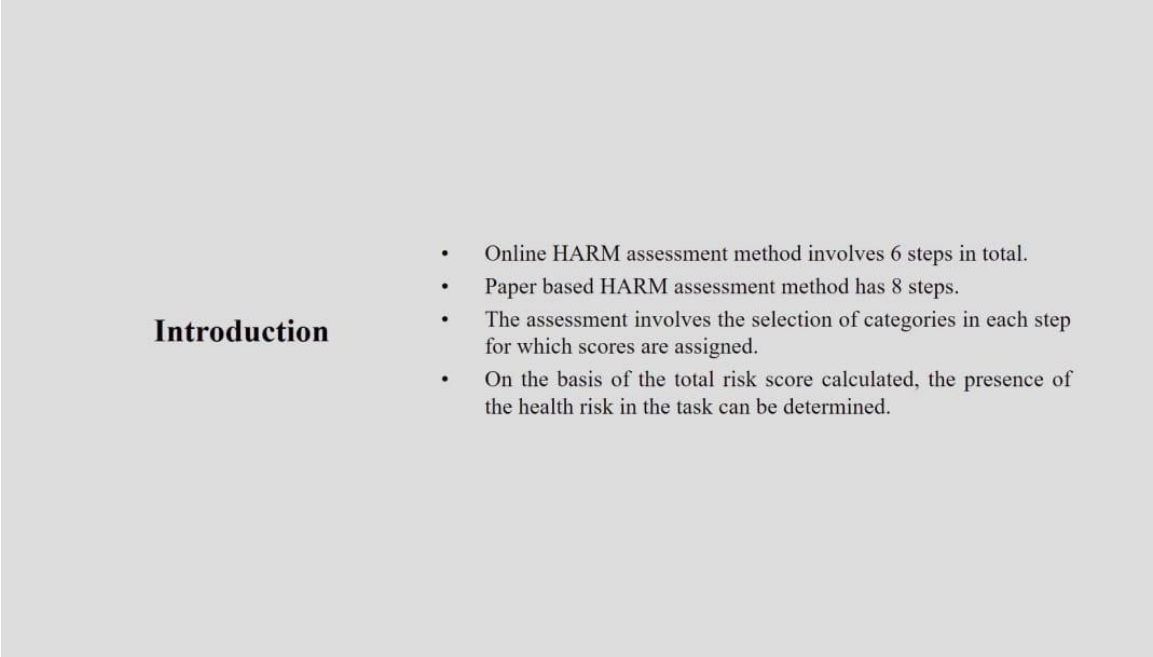
So, we are going to analyze all those series of tasks ok which is having a common goal and it is to achieve that goal we are exerting some kind of force. The defined task can be broad maybe it is a long task or it can be very small as long as what is included and what is not included are known to you. So, definition of the task that you are going to use for this particular analysis is very important. Before you start the analysis what you need to do? You need to define the task. It can be long enough or it can be very small, but once you know what it is then it is in easy for you to do the analysis.

Then force exertion is are the components within a task that involve the application of a force.



This can be applied to a task that take longer than 1 hour per day in a total only on task that involve one-handed force only with one hand. So, one-handed force exertion of less than 6 kg per 60 Newton. So, all hand and arm task other than computer work. So, computer work you cannot assess using this particular tool.

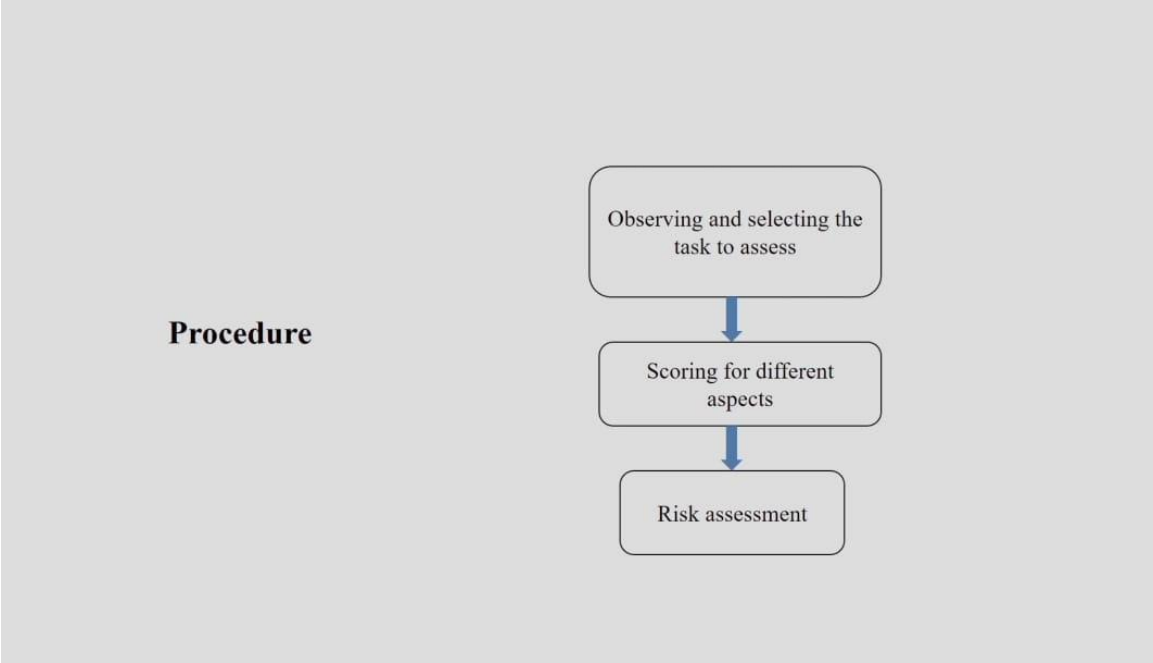
Unsuitable for task that primarily involve activities of the back and legs. So, you cannot assess anything which is related to where you need involvement of back and leg and can be used in industrial and service sector both the cases like in industrial sector as well as service sector. Whereas, you need to remember that these assumptions need to be fulfilled. If these assumptions are not fulfilled then we you will not be able to get the correct results using this particular tool.



So, online harm assessment method involves 6 steps in total and paper-based if you are doing it paper-based.

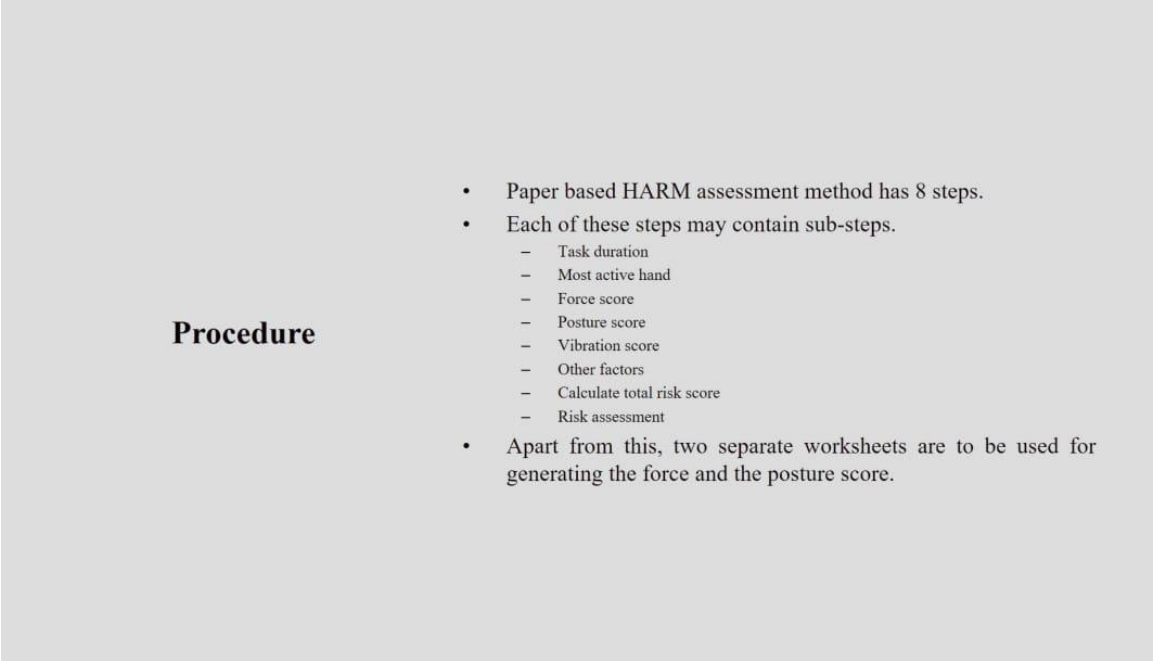
So, it has 2 modalities if you are doing in pen and paper in that case it has 8 steps. Now I will be discussing the basic steps of it if you are using online. So, software will help you to get the job done within 6 steps whereas, if you are doing with pen and paper because basic calculations will be done by the done in the back end when you are doing it with the online. But if you want to do it offline like with pen and paper then you have to do 2 more extra steps. The assessment involves the selection of categories in each step for which scores are assigned.

On the basis of the total score calculated the presence of health risk in the task can be determined. So, based on the score final score you will get the final interpretation, and then only you can understand where the intervention program can start.



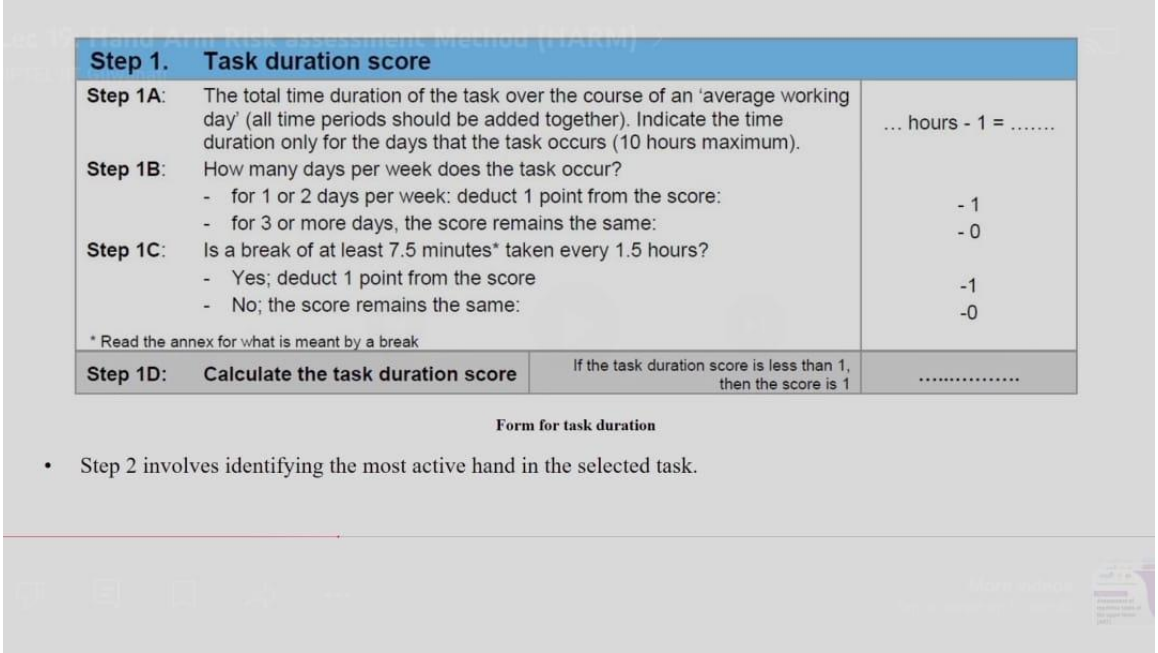
So, let us understand the detailed procedures. This is the outline of the procedure. First, you need to observe it, select the task which you are going to assess.

So, defining the task. So, starting point and ending point as I mentioned earlier it can be long enough, it can be very small as well. Once you select it then you have to give the scoring of different aspects, you have different factors to consider as we do in JSI or MFA, or RULA. So, you have different factors you give the scoring, here also you will be giving the scoring and once you have the scores then what you will do? You will do the risk assessment. So, let us go into detail.



The paper-based HARM assessment method has 8 steps and each step has some sub-steps we will be discussing. So, mainly they are task duration, most active hand which is like left hand or right hand. So, you have to find that, force score, posture score, vibration score, some other external factors, and once it is done then what you have to do the calculate the risk, total risk score, and risk assessment. You can understand from all these, these are compulsory steps that you need to follow or you need to do. For online maybe these part like can be done in the you know back end and you will get the results directly.

However, for your case when you are doing in pen and paper you have to perform it by yourself. Apart from these two separate worksheets are to be used for generating the force and posture data, we will understand them in detail.



Step 1.	Task duration score	
Step 1A:	The total time duration of the task over the course of an 'average working day' (all time periods should be added together). Indicate the time duration only for the days that the task occurs (10 hours maximum).	… hours - 1 = …….
Step 1B:	How many days per week does the task occur?	
	- for 1 or 2 days per week: deduct 1 point from the score:	- 1
	- for 3 or more days, the score remains the same:	- 0
Step 1C:	Is a break of at least 7.5 minutes* taken every 1.5 hours?	
	- Yes; deduct 1 point from the score	-1
	- No; the score remains the same:	-0
* Read the annex for what is meant by a break		
Step 1D:	**Calculate the task duration score** — If the task duration score is less than 1, then the score is 1	……..

Form for task duration

- Step 2 involves identifying the most active hand in the selected task.

So, first is the task duration score. In that you have small sub-steps, step 1A, 1B, and 1C. What are these? Also 1D.

So, what are these? It says the total time duration of a task over the course of an average working day So, it is not that you observe the task for only one day, you have to observe it for a period. So, from that you have to take the average calculation. So, the total time duration of the task over the course of an average working day, all time the period should be added together. So, indicate the time duration only for the day that the task occur.

So, 10 hours maximum. So, you can say that what is happening there and here then you can calculate the score. Now step B, how many days per week does that particular task occur? So, first is in a day how many hours they are doing. The second step is if they are doing the task then that particular task in a whole week how many times they are doing. So, for 1 or 2 days per week, you have to deduct 1 point from the score. If the for 3 or more days then score remains the same.

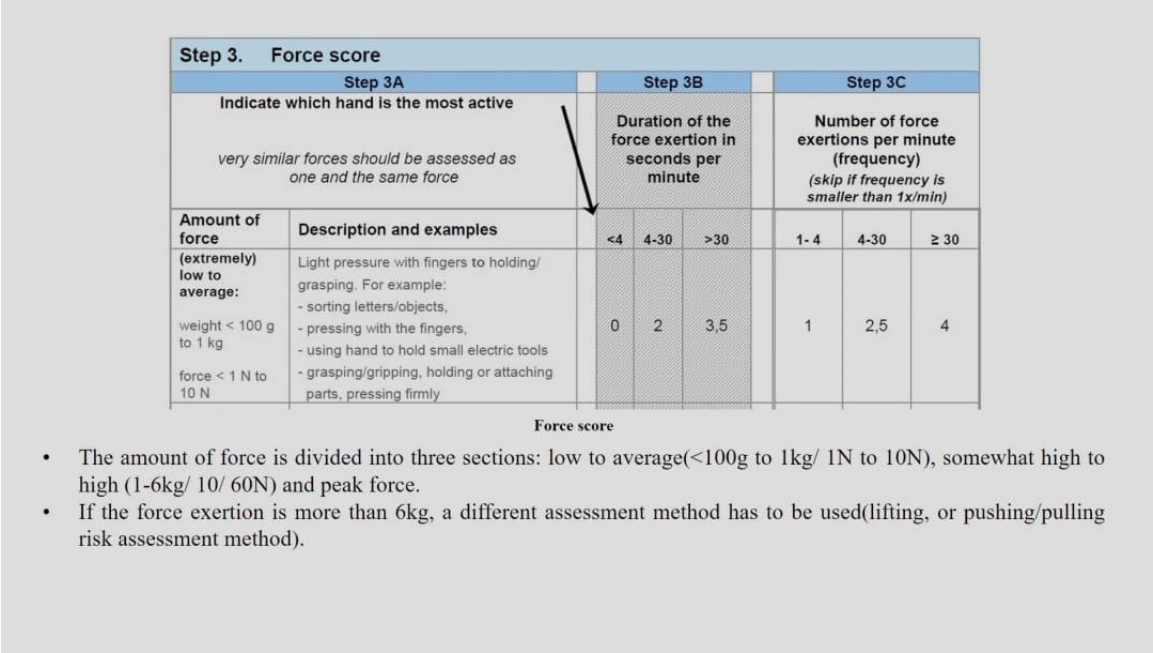
So, you are getting a score over here like suppose, for example, I am doing the task for 7 hours. So, the result is 6 over here. Now if we are in this particular case then it is 6 minus 1 it is 5 whereas, this is remain same as 6. Coming to the next step is a break of at least 7.5 minutes taken every 1 and a half hours.

If yes, so you are considering the recovery period. So, if some kind of rest ok 7.7 and a half minutes of break if you are taking after each 1 and a half hours while doing that particular job then you need to deduct that minus 1 like you have to deduct 1, or if no there is no break then what you have to do this score remain same. Now here the break is

it is there in the whole annexure in the actual paper. So, breaks are lunch break, your minute break or you know you're between 2 task there is a small break.

So, such all breaks you need to consider. Then final is the score like step D which says the calculate the task duration score. So, if the task duration score is less than 1 then score is 1. So, you have to get this value. So, this is for step 1 that is task duration score fine.

Next is step 2 involves identifying the most active hand in the selected task either it will be left or right. So, you need to identify that particular part which hand is mostly active.



Step 3. Force score

Step 3A		Step 3B			Step 3C		
Indicate which hand is the most active *very similar forces should be assessed as one and the same force*		Duration of the force exertion in seconds per minute			Number of force exertions per minute (frequency) *(skip if frequency is smaller than 1x/min)*		
Amount of force	**Description and examples**	**<4**	**4-30**	**>30**	**1- 4**	**4-30**	**≥ 30**
(extremely) low to average: weight < 100 g to 1 kg force < 1 N to 10 N	Light pressure with fingers to holding/ grasping. For example: - sorting letters/objects, - pressing with the fingers, - using hand to hold small electric tools - grasping/gripping, holding or attaching parts, pressing firmly	0	2	3,5	1	2,5	4

Force score

- The amount of force is divided into three sections: low to average(<100g to 1kg/ 1N to 10N), somewhat high to high (1-6kg/ 10/ 60N) and peak force.
- If the force exertion is more than 6kg, a different assessment method has to be used(lifting, or pushing/pulling risk assessment method).

The next step is the force calculation that is force score. What it says it indicates which hand is the most active. So, in the step 2, you identified suppose for an example your dominating hand is right hand So, for here we will be going for the right hand.

So, very similar forces should be assessed as one and the same force. So, how do you do? Here also you have step A, step B, and step C. So, 3A, 3B, 3C. So, let us understand first the step 3A. It says that you need to identify the amount of force.

What is the amount of force? So, there are two types. Now how this is the description. So, light pressure with fingers which is holding or grasping for example, sorting letters objects some small objects, pressing with fingers, using hand to hold the small electric tool electric tools, grasping, gripping, holding or attaching parts, pressing firmly all such activities will be considering. Next step that is the step 3B what you are going to do that is the duration of force exertion in second or you have to use it for seconds per minute how what is happening. So, duration of force exertion in seconds per minute.

So, if it is less than 4 then it is 0, if it is 4 to 30 then 2 then it is more than 30 then it is 3.5. Next is your number of force exertion per minute that is the frequency. Here also you have some pre-computed values. So, you have to see where you are standing.

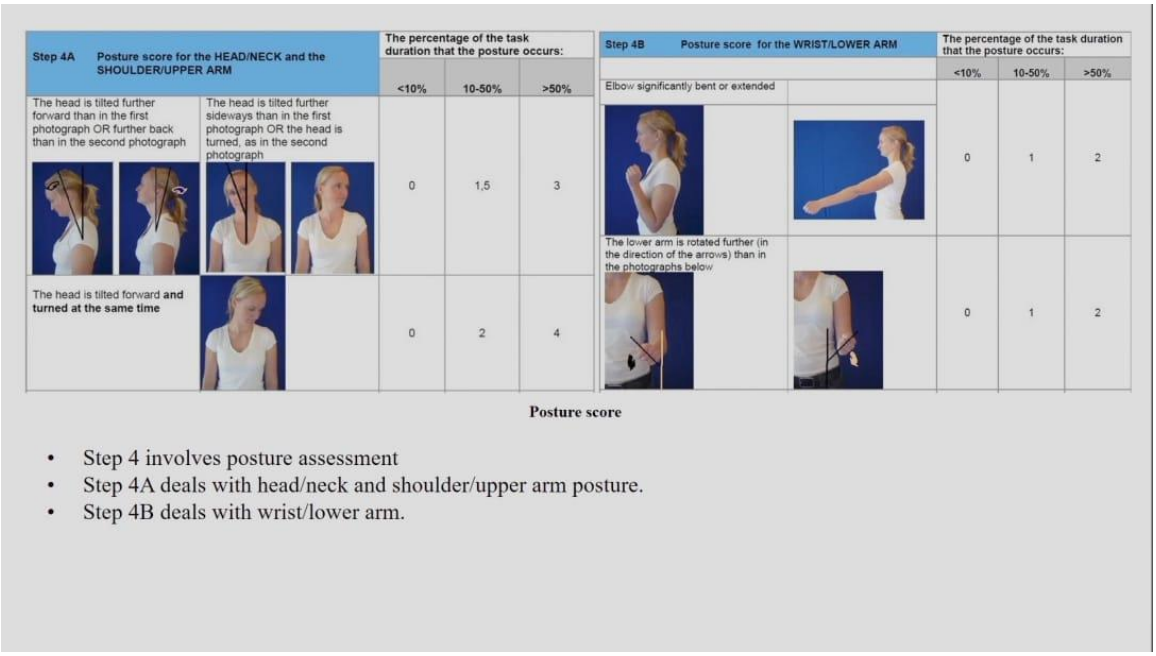
So, 3A, 3B and 3C. So, what here we are saying the amount of force is divided into three major section low to average that is less than 100 kg to 1 kg or 1 Newton to 10 Newton, somewhat high to high that is the 1 kg to 6 kg 10 or 60 Newton and the peak force. If the force exertion is more than 6 kg a different assessment method has to be used maybe lifting, pushing, pulling in that case this small activity. Here you can say this is light pressure. So, for that, only you can see the load weight. So, if it is less then only you can use it otherwise you may not use it.

Amount of force	Measure (for the forces that are exerted during the task) the duration of the force exertions over the course of one minute (repeat the measurement a few times)	Calculate the average duration of the force exertions in seconds per minute (STEP 3B) (Average duration per minute: Add up all the durations for each force exertion and divide by the number of measurements)	Make a new observation and keep a count of how often the force exertion occurs during each observation (also record how long you observed the task)	Calculate the number of force exertions per minute (frequency) (STEP 3C) **Frequency:** Number of force exertions divided by the duration of the observation in minutes: number of force exertions / minutes observed
(extremely) low: weight < 100 g Force < 1 N.	….sec ….sec ….sec	**Average duration per minute:** ..... seconds per minute	..... times in (K) ..... minutes	**Frequency:** =..... force exertion per minute
average: weight 100-1000 g Force 1-10 N.	….sec ….sec ….sec	**Average duration per minute:** ..... seconds per minute	..... times in (K) ..... minutes	**Frequency:** =..... force exertion per minute
somewhat high: weight 1-3 kg Force 10-30 N.	….sec ….sec ….sec	**Average duration per minute:** ..... seconds per minute	..... times in (K) ..... minutes	**Frequency:** =..... force exertion per minute
high: weight 3-6 kg Force 30-60 N.	….sec ….sec ….sec	**Average duration per minute:** ..... seconds per minute	..... times in (K) ..... minutes	**Frequency:** =..... force exertion per minute

Force calculation table

- Form for recording force exertion which will be the input for the table in Step 3.

So, regarding amount of force, this is the kind of detailed description. It is a table you can go with this and you can find your exact position. So, form for recording force exertion which will be the input of the table 3. So, you have to do the calculation from here force calculation table and you have to give the input over this particular table.



The next part is posture. So, posture score for the head or neck and the shoulder and upper arm. So, you can see there are two division one is for the neck and another is for the hand and shoulder, and upper arm. So, what it says the head is tilted further forward suppose you are here you are tilting it ok this side this side. So, you are tilting it further forward than in the first photograph. So, you see this is the position and here it is tilting and the head is tilted further on the sideways.

So, this way. So, you have to find out the percentage then you get the score. So, these are the scores. Now this is step 1 4A that is the neck and head and this is the posture score for wrist and lower arm. So, and then this is for the wrist and lower arm. What it is the position? The lower arm is rotated further ok lower arm is rotated further than the photograph below if it is not then you have to give the score.

So, you have to see the kind of percentage. Now you can ask that how do you calculate this type of percentage. So, what you need to do? You need to understand the basic range of motion and what is happening during their working posture. From there you can have the calculation. So, step 4 involves posture assessment. 4A deals with head, neck, shoulder, upper arm posture, and 4B deals with the wrist and lower arm.

And that is what is very easy from the photograph only you can you can see what is the current position of your situation of your case. So, you need to refer these photographs for your understanding for getting your score.

Postures		Keep a count of how often the posture occurs per unit of time (also indicate how long you bserved)	Duration of the postures (repeat the measurement a few times)	Duration of posture as a percentage of the task duration: = number observed x average duration / total duration of observation
The head is tilted further forward than in the first photograph OR tilted further back than in the second photograph			…. sec …. sec …. sec Average duration per time: ….. sec (G)	Percentage= ……(K) x ……sec (G) ……sec (O) =……%
The head is tilted further to the side than in the first photograph OR the head is turned, as in the second photograph		…… times in (K) …… sec (O)	…. sec …. sec …. sec Average time duration: ….. sec (G)	Percentage= ……(K) x ……sec (G) ……sec (O) =……%
The head is tilted forward **and turned at the same time**		…… times in (K) …… sec (O)	…. sec …. sec …. sec Average time duration: ….. sec (G)	Percentage= ……(K) x ……sec (G) ……sec (O) =……%

Form for recording posture

- The resultant values are used as the input for the Step 4A

This is in detail. So, you can say this is the form for recording the posture. So, this particular table you can use for your data recording.

This table will give you the value and this table will help you to understand or gather the information at the field. So, you take it as a data sheet and you give the ticking and you come back and then you do the calculation at the laboratory.

Step 5A The vibration intensity is unknown		
Which of the situations applies? Circle the corresponding score and put this in the grey box at the bottom of the table.	**Duration of exposure within the task**	
	0-4 hours	**4-8 hours**
Description	**Score**	
Hardly any vibration, or no vibrations perceived by the user or visible to the assessor	0	0
Vibrations not visible, but perceived by the user (quivering sensation)	2	2
Vibrations just visible on the lower arm/hand, clearly perceived by the user	2	4
The hands, arms or shoulders can be clearly seen to vibrate and vibrations are clearly perceived by the user	4	4
Vibration score: use the circled score:	……	……

Vibration score (intensity unknown)

- Step 5A assigns the vibration score to the task if the vibration intensity is unknown.

Next step is the vibration that is the 5A, vibration intensity which is unknown. Which of these situation applies? So, you need to ask what what is there ok? You have to circle

the corresponding score and put this in the grey box here here at the bottom of the table. So, what is the description? There are few description about the vibration because you do not know what is the exact amount of vibration, but from the description, you have to select the score.

So, hardly any vibration or no vibration perceived by the user are visible to the accessor, very very small amount of vibration. Now here also two important thing, one is the exposure limit. How long with that particular risk the person is getting exposed. So, suppose there is a small amount of vibration, but the person is getting exposed for longer hours the impact is very high. So, you can see here two major division about the duration of exposure, one is 0 to 4 hours another is 4 to 8 hours.

So, first division is very less amount of vibration, second division says vibration are not visible you cannot see, but you can perceive it. The third is vibration just visible on the lower arm. So, your lower arm is little shaking of course, clearly perceived you can see the scores are changing right, scores are changing are not very same. The hand, arm, and shoulder can be clearly seen to vibrate and vibration are clearly perceived by the user for those cases the score is 4. So, whichever the score is coming you have to write it down, here and here you have to write it down which one.

Because if the exposure level is 0 to 4 then this column, if the exposure level is 4 to 8 then this is this column. So, 5A assigns the vibration score to the task if the vibration intensity is unknown. Because most of the cases you will see you do not know what exactly the vibration intensity, because you may not have that particular instrument vibration meter that you may not have with you for measuring the vibration. What is the next step that is the if someone is knowing about the intensity of the exertion or intensity of the vibration.

Step 5B The vibration intensity is known		
	Score	
Which of the situations applies? Circle the corresponding score and place this in the grey box at the bottom of the table.	Duration of exposure for the task	
Vibration intensity	0-4 hours	4-8 hours
< 2,5 m/s^2	0	0
≤ 2,5 - 5 m/s^2	2	2
≤ 5 – 10 m/s^2	2	4
≥ 10 m/s^2	4	4
Score for vibration: use the circled score:	.....	.....

Vibration score (intensity known)

- Step 5B assigns the vibration score to the task if the vibration intensity is known.

So, you can see if you know the intensity of the exertion you can see the limit and according to the exposure score, you can give the scoring.

It is very easy this is for unknown intensity and this is this is for intensity So, step 5B so, anyone it is not that both will be there, anyone will be there. So, 5B assigns the vibration score to the task if the vibration intensity is known to you.

Step 6. Other factors:	
Indicate whether the following situation apply to the task	Circle the correct answer
Breaks can only be taken at set break times (as opposed to breaks taken at the employee's discretion)	Yes/no
Work with cold or wet materials is performed without gloves	Yes/no
Disruption to concentration occurs regularly (only if work requires concentration)?	Yes/no
Hand grips are not shaped or are slippery or wet. Stretched fingers or a 2- or 3-finger pinch grip often occur because large or small materials are gripped or held	Yes/no
The work performed is a precision task. It requires precise positioning or moving of fingers or hands, such as assembly of very small pieces or surgical actions	Yes/no
Score for other factors: 0,5 for each 'yes' above:	.....

Other factors

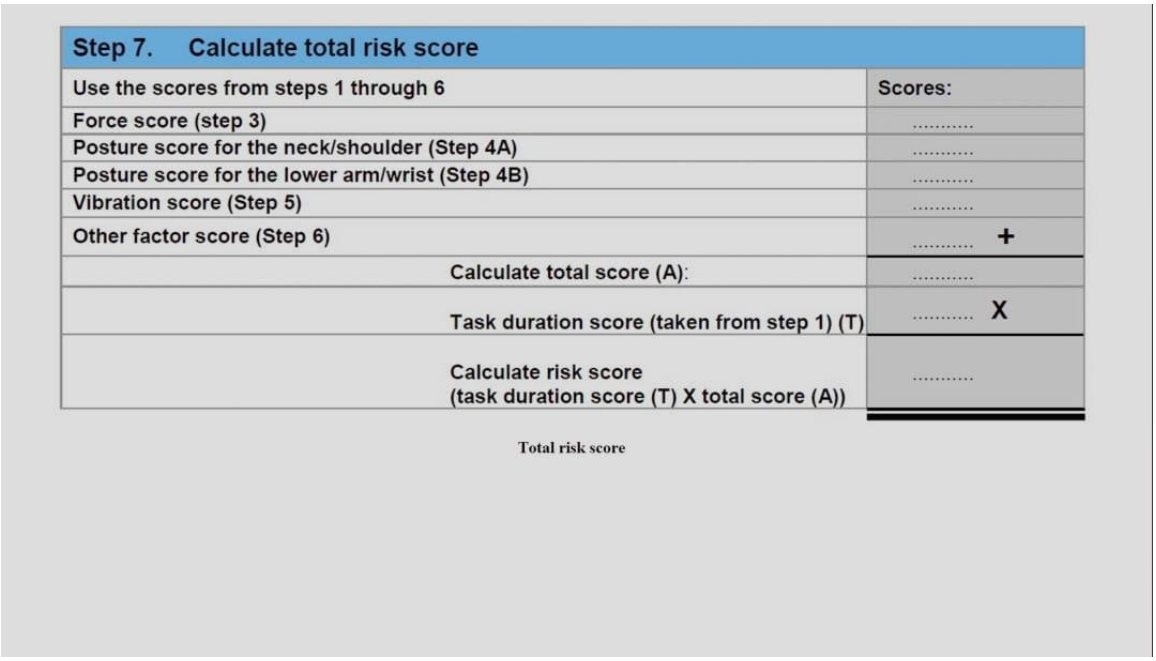
Some other factors which is going to impact. So, we need to understand that breaks can only be taken at set break time ok which is predefined.

So, you have to give the answers it is yes or no. So, dichotomy variable. So, work with cold or wet materials is performed without gloves. So, you can understand that it is talking about personal protective equipment. She exposure to the extreme environmental condition thermal condition. Disruption to concentration occurs regularly there is some kind of external factor which is causing disturbance in the actual job.

Hand grips are not shaped or are slippery or wet stretched fingers or a 2 or 3-finger pinch grip often occur because large or small materials are gripped or held. So, you can understand if there are something very small you are holding it like this. So, you are you are using these fingers to hold it you know you are taking lot of strength. So, if that strength is required for longer hours you can see these muscle groups even these muscle groups are somewhere involved. So, you are trying to understand what are the other external factors are present.

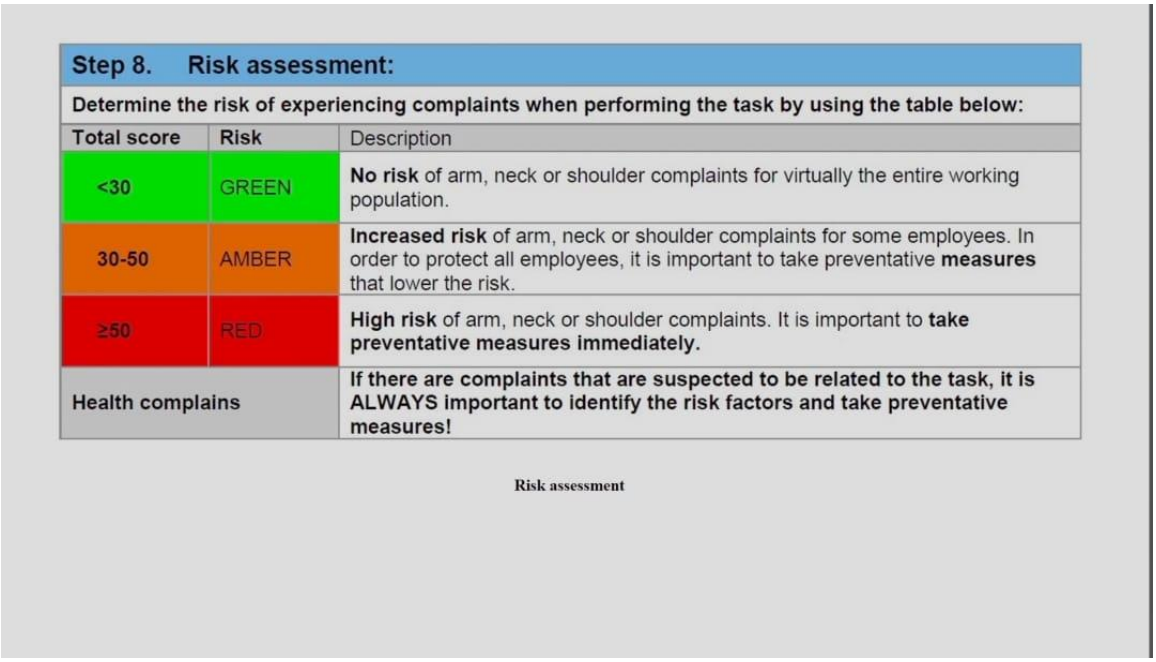
The work performed is a precision task or not. So, if it is a precision task you need the holding your neck posture very firmly. So, if you are holding it because if it is a precision job or precision task you need lot of hand-eye coordination and concentration. So, the work performed is a precision task or not. It requires precise positioning or moving of a finger or hand such as assembly of a very small pieces of or surgical actions whatever it is watch making, jewellery making for such cases you really need lot of visual concentration. To get that visual concentration your neck muscles, shoulder muscles, upper trunk muscles, and even fingers need lot of force to hold that particular posture.

So, you are trying to understand those important external influences as well. So, these are the other factors. So, you have to score them 0 or 5 for each yes for all these cases. So, you need to give the value to it.



Now, you have to give the scoring. You have to calculate the that is the step 7 that is the calculate the total risk score. So, use the score from the step 1 to 6 from this then force, then posture, either neck and shoulder, and the lower arm and wrist both the cases. Now vibration only one if known or unknown whatever it is and then other forces then you add all these value together. So, you get the total score of A. Now once you get that then what you have to do with that you task duration score.

You have a task duration score you have to multiply that and once you get that score then it is the calculate the so task duration score that is the T and the total score that is the A. Suppose here you have total score that is 6 and task duration score suppose we are going back and taking a random value task duration score suppose 6 task duration score suppose 6. So, here it is 6. So, 6 into 6 it is 36 something like that you will be getting that is the total risk score. Now, I am saying this we have not touched this is a random value I have assumed.



Step 8. Risk assessment:		
Determine the risk of experiencing complaints when performing the task by using the table below:		
Total score	Risk	Description
<30	GREEN	**No risk** of arm, neck or shoulder complaints for virtually the entire working population.
30-50	AMBER	**Increased risk** of arm, neck or shoulder complaints for some employees. In order to protect all employees, it is important to take preventative **measures** that lower the risk.
≥50	RED	**High risk** of arm, neck or shoulder complaints. It is important to **take preventative measures immediately.**
Health complains		**If there are complaints that are suspected to be related to the task, it is ALWAYS important to identify the risk factors and take preventative measures!**

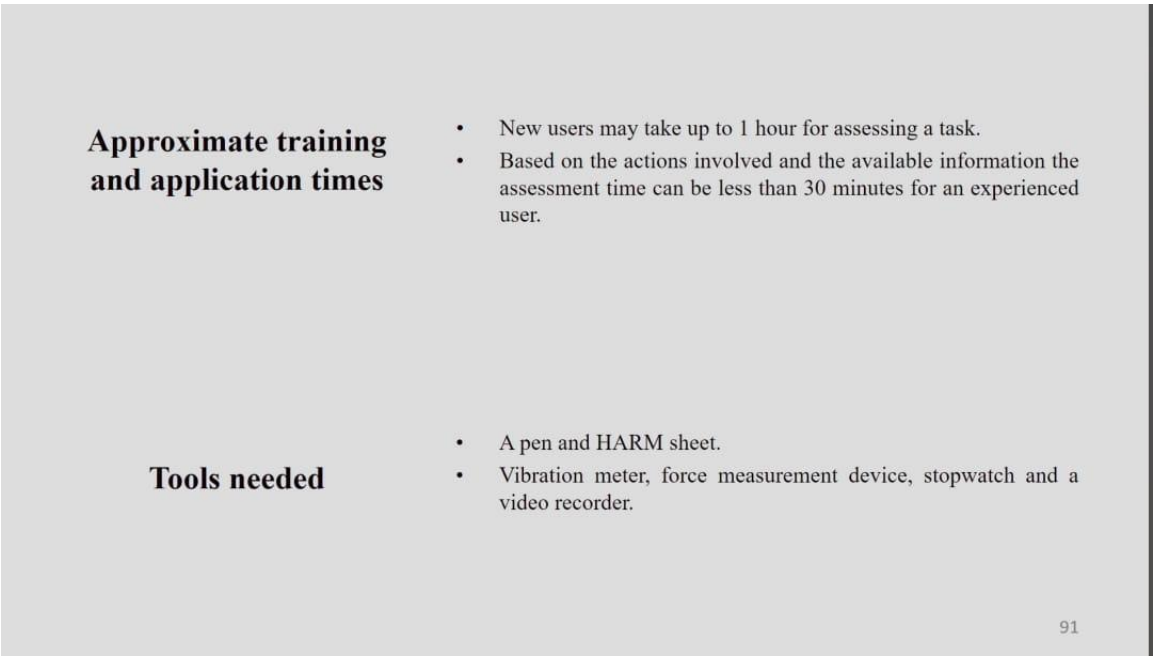
Risk assessment

So, you can do for your case. So, if it is less than 30 then it is green that means, there is no risk. So, no risk for arm, neck, or shoulder complaints of for virtually the entire working population. Now it may happen there are some different situation. Those situation may be associated with some other factor. If you have so you have to identify them separately, but approximately we can say they are in safe zone 30 to 50 that is the amber region.

So, increased risk for arm, neck, shoulder complaints for some employees in order to protect all employees it is important to take the preventive measures that is going to help to lower the risk. And more than 60 or equal to 60 is risk that is the high-risk red alert. So, high risk of arm, neck, or shoulder complaints. It is important to take preventive measure immediately. So, similarly, for other tool we are also having a kind of you know region green, amber, and red.

So, what are the health complaints you supposed to receive for such cases? If there are complaints that are suspected to be related to this task it is always important to identify the risk factors and you need to take the preventive measure. So, this is the kind of intervention point interpretation points. So, from these interpretation what you need to do? You need to take these results further and you have to see which factor is causing. So, you have so many factors you have force, you have posture, you have vibration, you have some other influencing factors, recovery period. So, all these factors among all these factors which is causing the enhancement of the total score you need to identify that and from there you have to go for the design changes or intervention program.

Maybe it is manpower calculation, maybe it is work rest cycle calculation, maybe it is the redesigning of the workstation or it can be anything else. So, this is how you are going to use harm.



So, what is the approximate time? So, new users may take up to 1 hour for assessing this particular task based on the actions involved and the available information the base assessment time can be less than 30 minutes for an experienced user. So, what do you need? You need pen and paper and if you have a software like online version available with you then with the pen and paper whatever information you are collecting you can transfer it to them and they will give you the final results. So, vibration meter sometimes if you want to precisely measure the vibration you can have the vibration meter, force measurement device to understand the exhaustion of force, stopwatch definitely you are talking about the duration of exposure, and a video recorder So, with the video recorder you can have the clear picture that when and how it is happening Now, I will tell here it is not written about the advantages and disadvantages of this tool.

Still, I would like to mention over here this tool is only applicable where your upper extremities So, shoulder, arm, neck, and this part so, wrists are involved only for those cases you can use it. Whereas, if it is weight limit of this manual handling is more than some 60 kg then it is not possible to use this particular tool for that case you need to do the some kind of pulling, pushing, lifting, or like you know LEO lifting equation or MSE or any other tool this tool in that case will not be applicable. So, this and also the advantage of this tool is you get a very clear picture of the situation of that particular task. So, you cannot have multiple assessment of multiple task at a time you have to do it separately you have to compare it separately. Also, the advantage of this tool is it can

give you a better understanding if you do an intervention the what is the impact of that intervention.

So, if you have a before data and after data, you can have an comparison and you can understand that is there any positive impact of your intervention in that particular task or not that is all for HARM. I suggest again similarly what I do for all other tool you practice you take an example you practice it calculate it and try to understand how you can take it further for your own research studies. If you have question you can come back and we can discuss it in our discussion forum. Thank you.