Ergonomics Research Techniques

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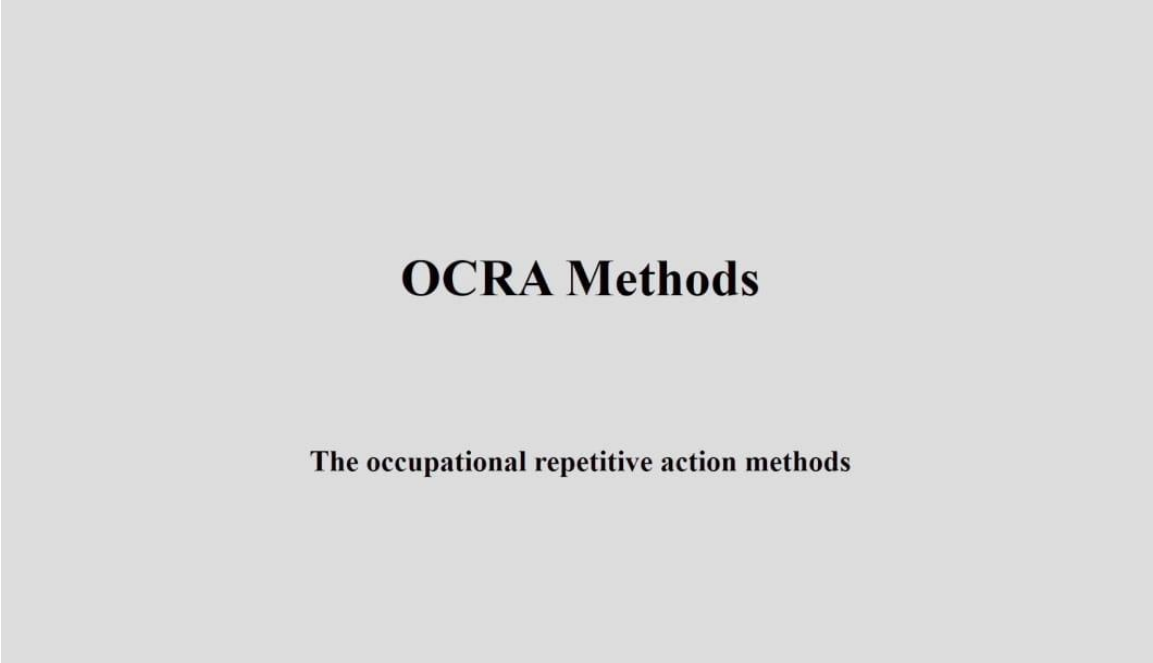
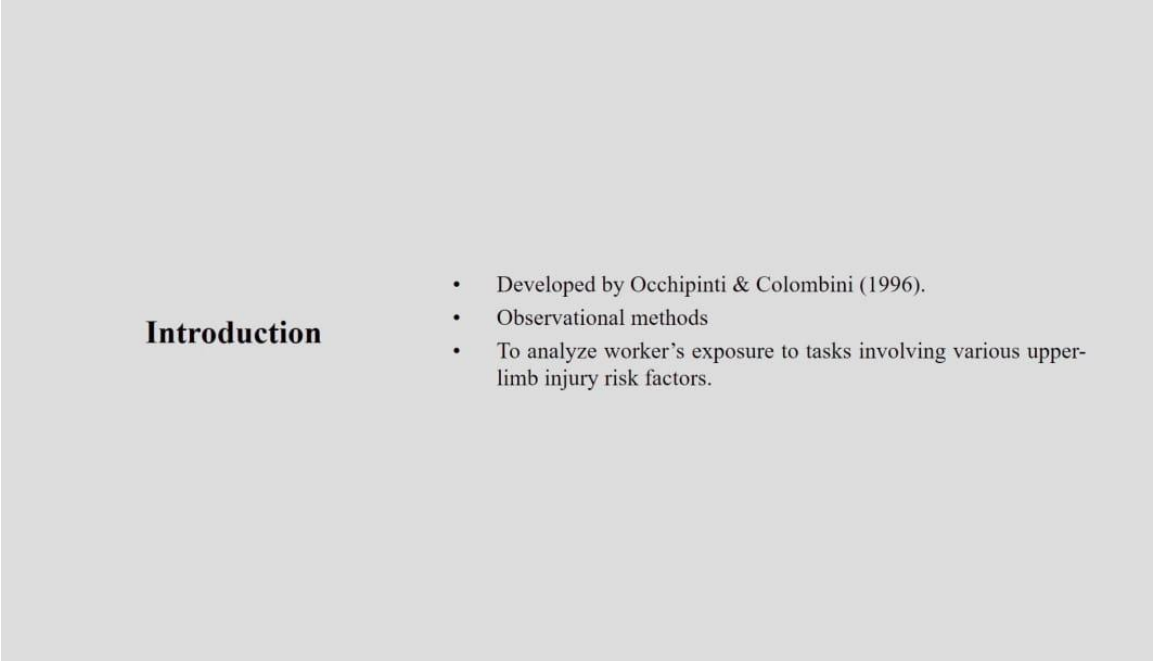
Week – 05

Lecture - 18

Lec 18: Occupational repetitive action methods (OCRA) methods

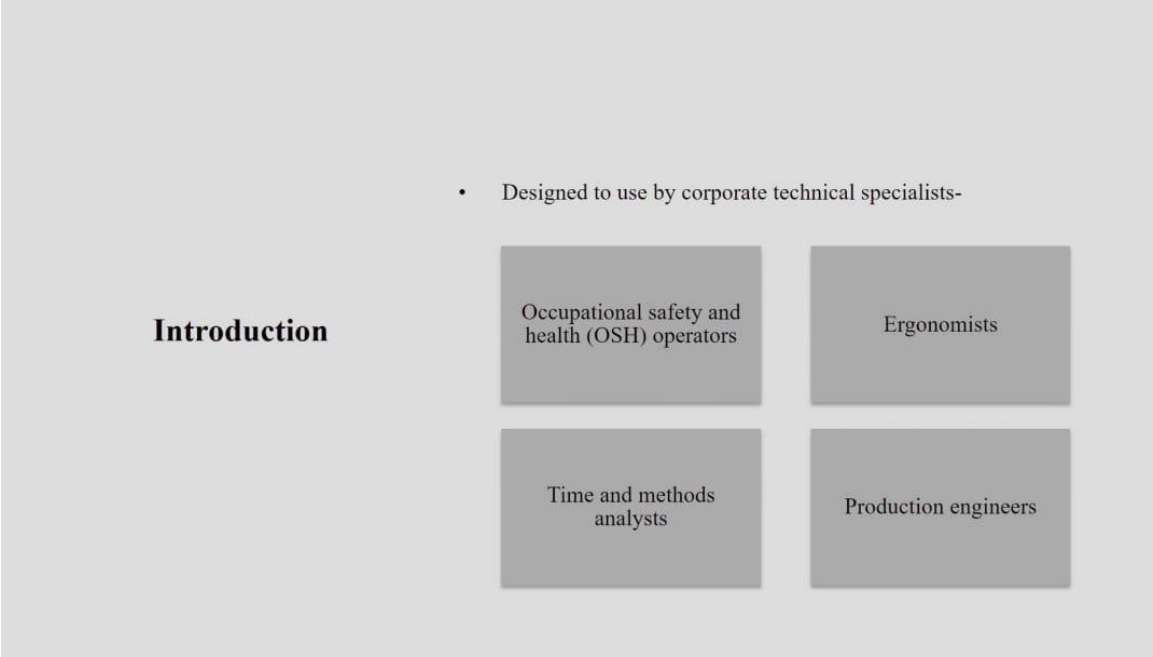


Welcome. Today we will do the understanding of occupational repetitive action method. So, the name is very popular as OCRA method. Here we get two varieties of evaluation, one is OCRA index another is OCRA checklist. So, this is mainly for your upper arm, shoulder, neck and these are the regions where we get an understanding what are the difficult situations are there and what are the deformities are there and how do we understand the risk of these factors in any workplace or working condition or work situation. So, the name of this method is OCRA method, the occupational repetitive action method, occupational repetitive action method. So, this is OCRA.



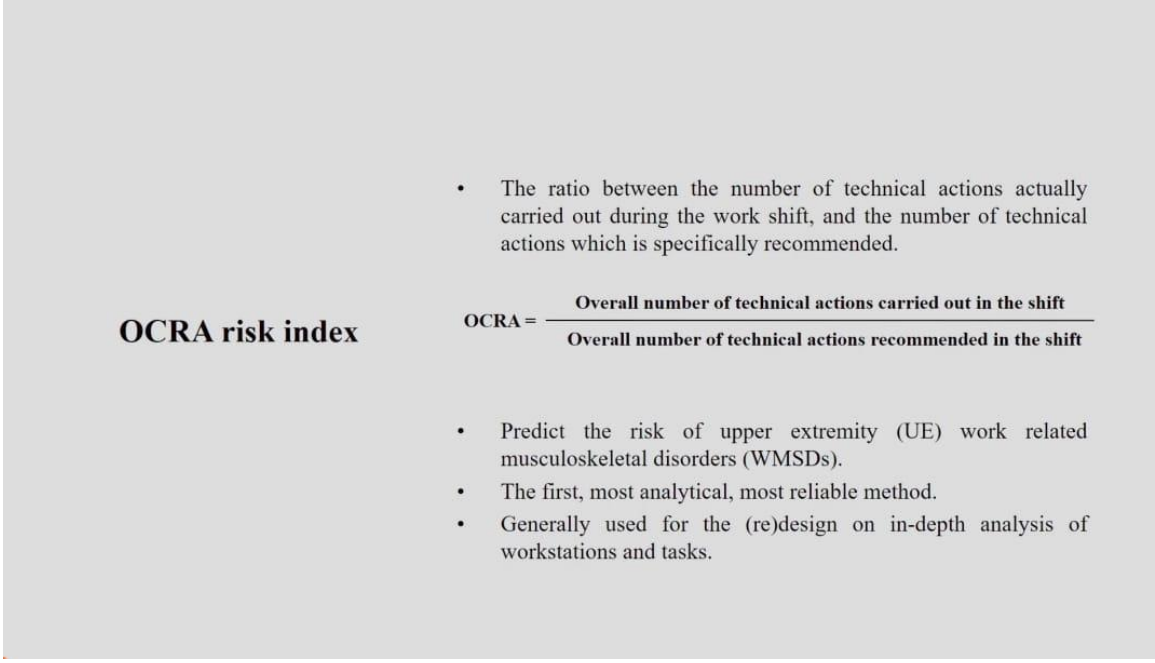
Who developed this? It is in 1996 professor Colombini and Occhipinti developed this particular tool or this particular method. It is an observational method. So, if you have some video recording or if you are going to a particular workplace and you are doing an direct observation probably you will be able to get the information and you will get the OCRA index and the OCRA checklist.

To analyze for what this particular tool is, this tool is to analyze the workers exposure to a particular task involving various upper limb injuries risk factor. So, I just would like to mention over here this particular tool is majorly for the upper limb disorder or upper limb related risk or hazardous work. So, anything which is related to lower limb or you know legs or your trunk we will not be able to use this tool. It is only for the upper limb. So, shoulder, upper arm, lower arm these are the areas where we will get the analysis and when somebody is involved in a particular task or in a particular work situation where these are these body parts are involved then only we can use this particular tool.



This particular tool is designed to use by corporate technical specialist. First component who are there in this particular development occupational safety and health operators. So, the people who are doing their task or doing their activities in this particular profession they were involved definitely different ergonomist who are renowned ergonomist they were involved time and method analyst. So, from the industrial engineering perspective time and method analyst and the production engineer because ultimately we need to see that is there any impact on the final productivity of that particular workplace or workstation. So, these are the four major contributor to develop this particular tool and to use this particular tool.

So, who are they once again let us understand occupational health safety operators, ergonomist, time and method analyst and production engineers. But it is not like that only these are the people who can use this particular tool given from the result of this tool or interpretation of the tool can be used by other professionals like designers, occupational therapist, physiotherapist and many others, but they are the major contributor. So, as I mentioned it has two major component one is OCRA risk index another is OCRA checklist. So, let us understand what is OCRA risk index.



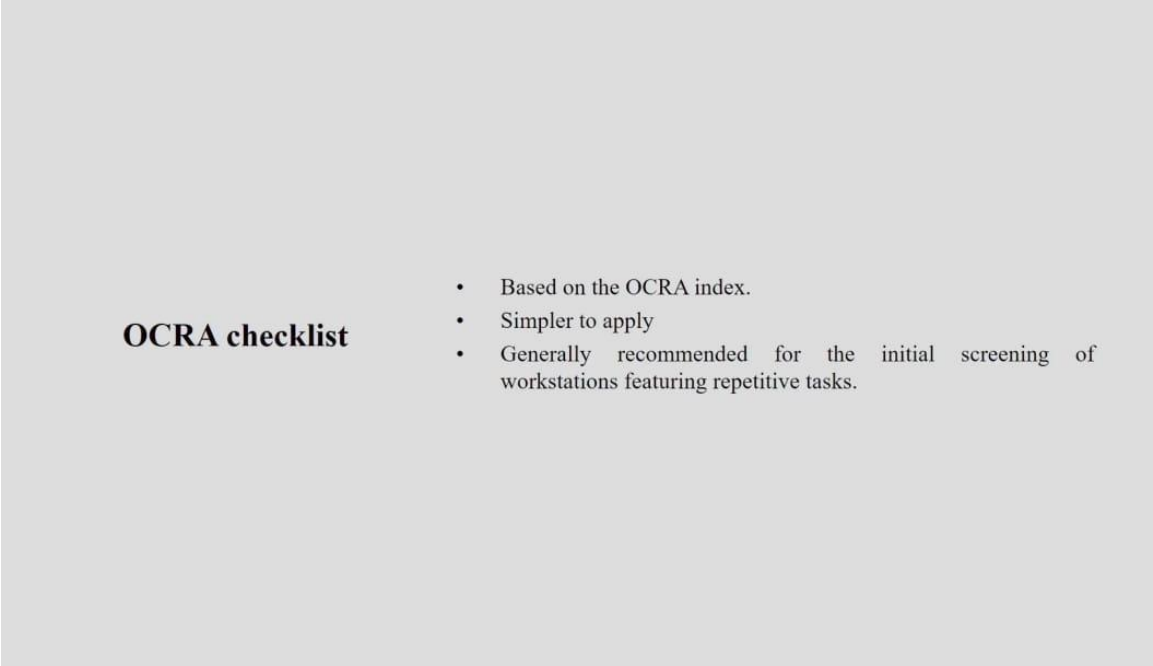
So, here we have two major terminology that is the overall number of technical action carried out in a particular shift.

So, in this whole method this technical actions are very important. So, we will be actually counting these technical actions. So, overall number of technical action which is being carried out in a particular shift divided by overall number of technical action which is recommended in that particular shift. So, ratio between these two are called as OCRA index. We can say that the ratio between the number of technical action actually carried out during the shift and number of technical action which is specifically mentioned or recommended for that particular task is your OCRA index.

What it does? It actually predict the risk of upper extremity work-related musculoskeletal disorder. Here I would like to mention whatever these tools we are talking about these are mainly associated with work related musculoskeletal disorder not anything else not any other musculoskeletal disorder. Suppose a specific kind of musculoskeletal symptoms or musculoskeletal disorder which is associated with any other causal factor like maybe pregnancy, maybe gender or maybe weakness of some muscle groups or something those we will not be able to assess using any such tool only which is related to work-related. So, causal factors are from work for those cases only these tools are you know we will be able to use these tools otherwise it is not going to give you a correct result. So, here it is only upper extremity work-related musculoskeletal disorder.

The first most analytical and most reliable method for upper extremity and generally used for the redesigning. So, you have a design you are redesigning it or before you

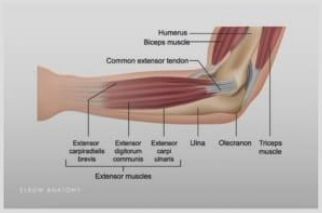
design you are trying to understand if this is a design then what is going to happen. So, either in design process or in redesigning process this particular tool is used on in depth analysis of the workstation and work task. So, this is very important we are only talking about workstation designing, redesigning and the task designing or redesigning. So, from this OCRA index and OCRA checklist we are going to do this much.



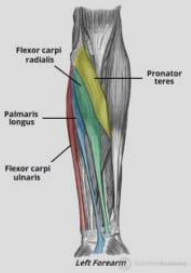
What is OCRA checklist? So, it is based on your OCRA index and very simpler to apply and generally recommended for the initial screening of workstation featuring repetitive task ok which is involve your upper extremity and which is repetitive in nature. For such cases this is a screening tool and this can be used to understand or majorly to identify the risk factor and going to help you in deciding that what are the elements can be redesigned to improve the situation. So, that is OCRA checklist.

Body parts assessed in OCRA methods

Hands

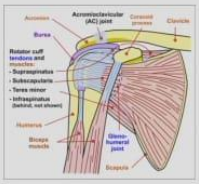


Elbow



Forearms

Wrists



Shoulder

So, these are the major body parts that we are going to get the analysis. First is your hand, elbow, wrist, forearm and shoulder. So, it is the whole upper extremity.

Work settings

- Any jobs in manufacturing and the service sector that involve repetitive movements and/ or efforts of upper limbs

Mechanical components

Electrical components

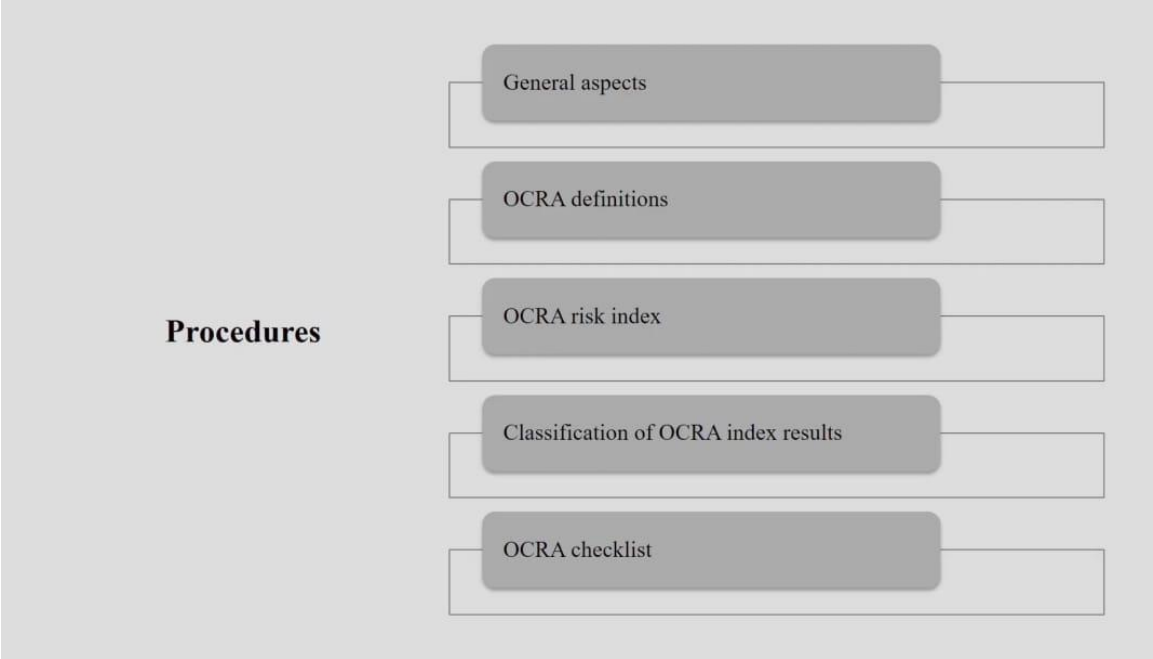
Automobile

Textile & clothing

Ceramic

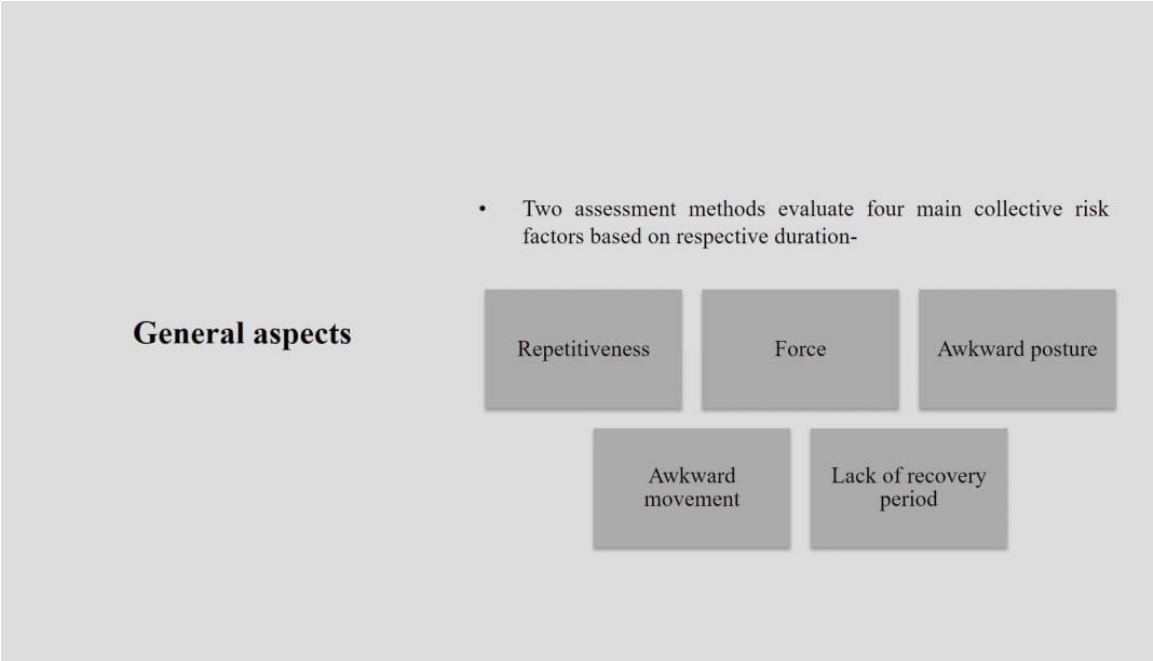
Food processing

So, these are some example where you can get such like if your workstation is like this then you can use this particular tool, but not only these are limited cases you can use this particular tool wherever your upper extremity is involved and is going to have some kind of repetitive task. So, these are some example.



Now let us understand what is the procedure to do this particular analysis. First is your general aspect, then OCRA definition you have to define it, then you have to do the OCRA risk index that you are going to calculate it, then you are doing the classification OCRA index result classification and finally, the OCRA checklist.

So, this is the procedure that you are going to follow for this particular method. So, let us understand what are the things available in general aspect,



what exactly it mean to assessment method which evaluate four main collective risk factor based on repeat respective duration. What are those? Repeatativeness. So, these are the factors that you are going to get the information and it is going to help in your OCRA index calculation. So, repeatativeness, force, awkward posture, awkward movement and lack of recovery period.

Now if you look at each factor over here, you can see all are the causal factors of your any kind of musculoskeletal disorder. When you are talking about repetitive activity, of course, it is major contributing factor for your any cumulative trauma disorder or you can say musculoskeletal disorder. Suppose if it is very high or you are doing it in a repetitive manner, then also it is bad, awkward posture of course, if it is static or dynamic whatever it is, it is going to cause a lot of muscle load or extra load on your that particular group of muscle and lack of recovery period. So, this is very important. Suppose you are getting exposed to some kind of awkward posture.

So, two separate similar person is going to get an exposure to an awkward posture. One is getting enough recovery time to settle down and again he or she is doing whereas, the other person is not getting the enough time to settle down, and without coming back to the base level he or she is starting the job. Definitely, the second person is more prone to develop musculoskeletal disorder. So, this recovery period that is why it is called cumulative trauma disorder. So, small small trauma is going to accumulate and that is going to cause the disorder.

So, understanding of recovery period for any particular job is very important. Many tools cannot explain this particular factor properly whereas, they consider repetitiveness, force, awkward posture, awkward movement many things. See if you remember JSI or MFA those tools are very they even considered the duration of exposure. However, this recovery period how long they are doing and once they are stopping the work after what is the duration they are again starting that job. So, that the muscle group is coming back and getting relaxed properly.

So, what is happening that recovery recovery period that is not being explained in any other tool. But in this particular OCRA method or OCRA index we are going to get that particular information. So, this is very important tool if you can use it you will get more detailed and inside insightful analysis.

General aspects

- Other additional factors-

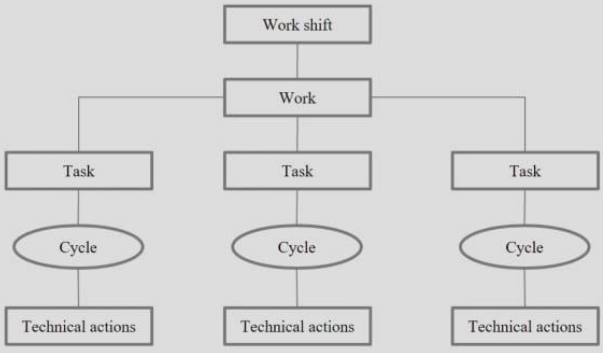
Mechanical	Environmental	Organizational

- Each risk factor is described.
- Then each factor is classified to help identify possible requirements and preliminary preventive interventions.

Now other additional factors that is going to help you in this particular method that is the mechanical factor of course, environmental factor and organizational factor. We will describe or we will explain we will discuss these factors separately in few slides or in the in the next few slides.

So, each factors is described and then each factor is classified to help identify possible requirements and preliminary preventive intervention. So, that is going to be done during this particular process.

OCRA definitions



- **Work** is composed of one or more **tasks** in one work shift.
- Within a single task,
  - **Cycles**- A sequence of technical actions
  - Repeated over and over, always the same
- Within each cycle,
  - **Technical actions**- Elementary operations that enable the completion of cycles
  - E.g., Take, place, turn, push, pull, replace.

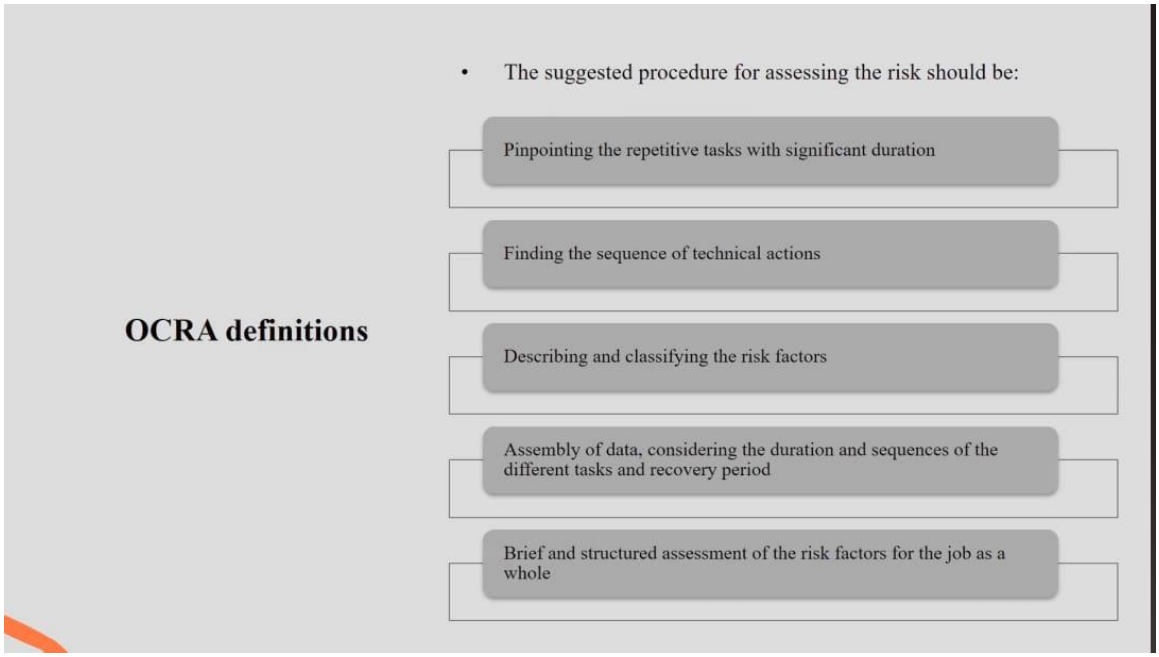
So, let us understand what is OCRA definition? So, you have a work shift under that you have a single work and under that, you have several small small tasks maybe 2 tasks maybe 3 tasks, or maybe 4 tasks and each task will have their own cycle time and in each cycle, you may have small small technical actions to be performed. OCRA index is interested to understand those small elements which is called technical action. So, if you look at your job that you are going to analyze.

So, look at that particular work shift you find out that particular work which you are going to get the analysis done under that particular work you let you try to understand what are the major task going to be done to complete that and then you will see that for each task you have a specific cycle time. So, you are getting the repetition. So, this repetitive factor is coming into picture. So, once there is a repetition what will happen while doing that particular task you have very small small elements in that particular task. So, that is the technical action.

So, let us understand the definition of each item. So, work is composed of one or more task in one work shift within a single task there will be cycle a sequence of technical action and repeated it it will be repeated over and over again always for the same duration same sequence ok that is important and within each cycle there will be some technical action. So, elementary operation that enable the completion of the cycle. So, for example, take the pen place it some place take the screwdriver tighten it grasp it. So, these are the technical elements.

So, maybe we once we study somewhere you know task analysis motion analysis and all those cases there also we have therbligs. So, those type of small small actions here we do not call them as a therbligs which is being which is a terminology for your you know task analysis and all those cases like time study motion study for those cases whereas, we will be calling them here as the technical action. So, you understand. So, these are at the micro level. So, you have a bigger job then you have a small small elements under each element you have a small cycle and each cycle will be completed by repetition of very small element or we will call them as the technical action.

This sequence you need to understand you have to detail it out before you start any kind of OCRA analysis.



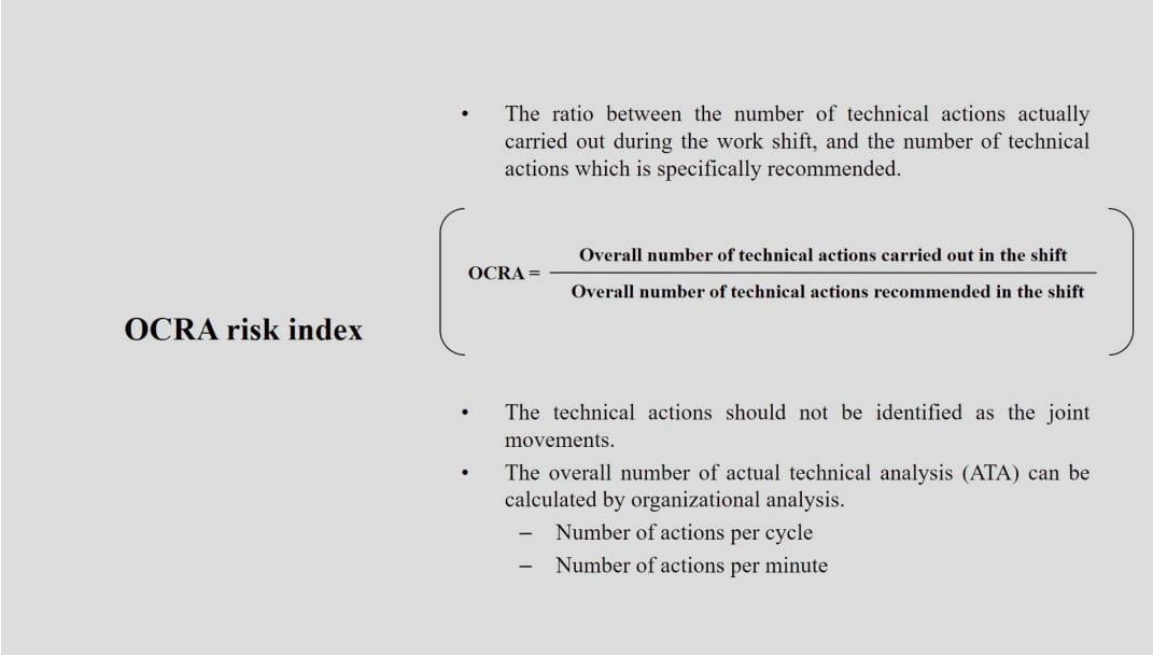
So, OCRA definition the suggested procedure for assessing the risk should be pinpointing the repetitive that is why I am saying very important part of OCRA is repetition. So, pinpointing the repetitive task with significant duration, pinpointing the repetitive task with significant duration, finding the sequence of technical action that is the job of the researcher, describing and classifying the risk factor, assembly data, considering the duration and sequence of the different task and recovery period, and then you need to brief and structured the assessment of the risk factor for a job as a whole. So, what you have to do? First, you have to identify the small element which you are going to get a repetition that small action. Once you have that finding the sequence of action.

So, maybe you have one technical action which is getting repeated you identified. You see that in the same cycle, there is another technical action which is also getting repeated. Maybe two or three such elements are there or you can say two or three technical actions are there in a whole cycle. Now you have to again identify once you have that you have to describe it. This is the technical action that you are going to consider as the action number 1.

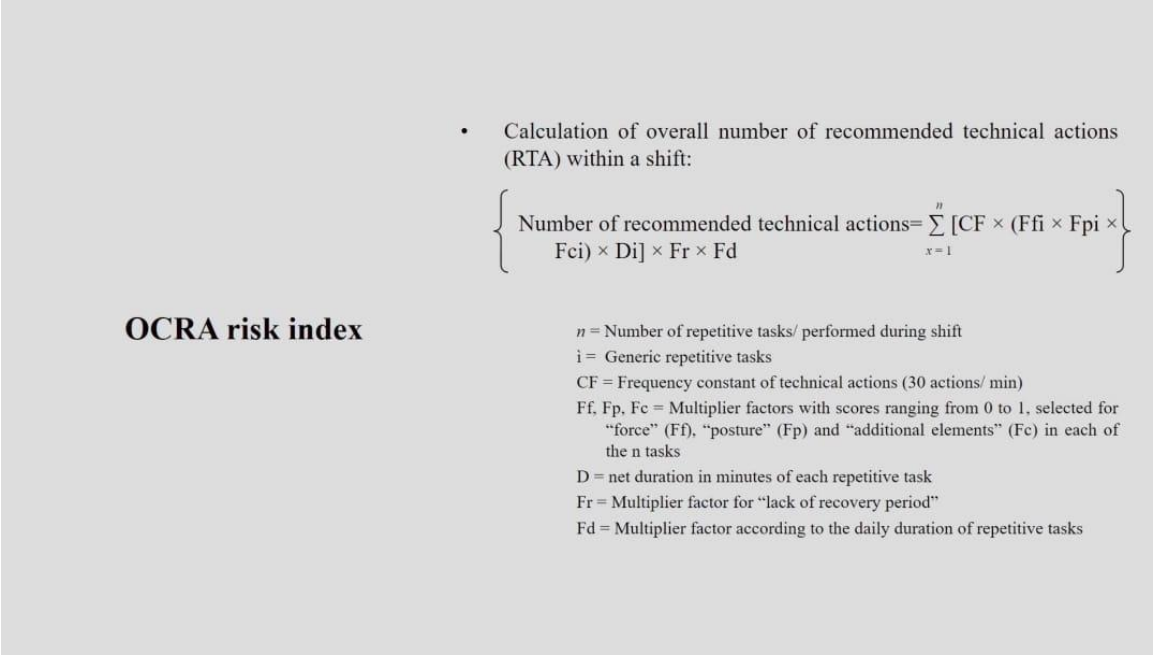
This is second so action number 2. Then 3 action number 3 something like that you are going to define it. Once so that there is no overlapping of action 1 and action 2 there is no common element between that. So, your timing are very specific. So, done once it is done then what you have to do? You have to give a sequence. So, this is technical action and this is going to be performed at the very beginning.

This is second, third, fourth, and fifth maybe this is the concluding technical action. So, that way you have to create the cycle. So, that is why it is saying that you have to brief

structured assessment of the risk factor of the job as a whole. So, that is very detailed job that you need to do while doing the or while defining the OCRA.



Done. Next is your OCRA index. So, as I mentioned earlier that overall number of technical action carried out in a particular shift divided by the number of technical action recommended in the shift. So, this is the definition. So, number of action per cycle and number of actions per minute we need to calculate. So, let us understand this particular thing in little more detail. So, we are what we are getting? We are getting RTA that recommended technical actions.



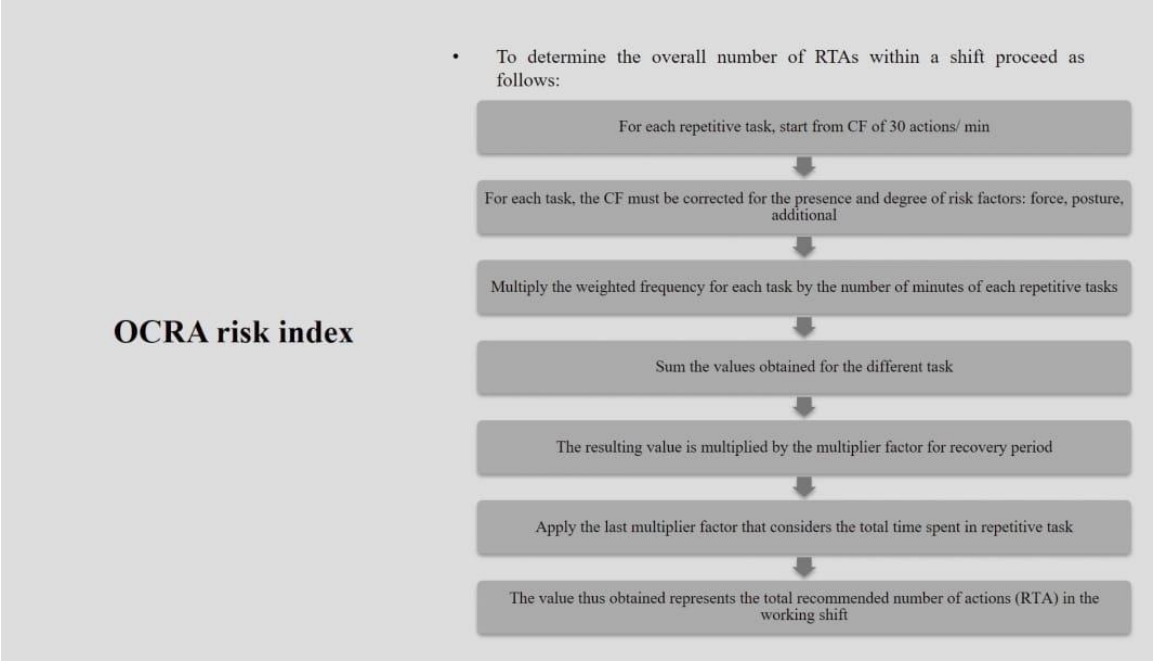
So, calculation of this particular you know variable we do using this particular formula. So, what it says? The number of technical action which is required to be performed in a particular shift is equal to summation of CF plus multiplied by Ffi, Fpi, Fci multiplied by Di, Fr, and Fd. Now let us understand what is meaning of all these names or all these variables. So, it is here and you can see we can do up to n numbers. So, number of repetitive task performed during shift.

So, you have suppose four such repetitive task. So, you have to do it for individual four task and you have to then sum it up. So, i is the generic repetitive task and CF that is the frequency. So, frequency constant of technical action that is the 30 actions per minute that is the constant value. So, from there only you are going to get your recommended technical task.

So, you can count your actual technical task using your stopwatch or any other method and using this particular formula you are going to get your recommended technical task. So, Fp, Ff, Fc are the multipliers or multiplying factors with scoring ranging from 0 to 2. So, you have a range, and selected for force is Fp, posture that is the f sorry force Ff. So, factor for force, factor for posture, factor for additional element that is the Fc. In each task, so you suppose you have n number of task.

So, here you will get n number of Ff, Fp, and Fc values. D means the net duration in minute of each repetitive task, net duration of minute of each repetitive task. What is Fr? Fr is the multiplier factor. So, you must be remembering the multiplier that particular concept which is there in you know in NIOSH, it was there in JSI. So, similarly here also we have the concept of multiplier.

So, these are all precomputed. So, multiplier factor for lack of recovery period, this is very important as I mentioned earlier also this particular tool OCRA index consider the recovery time. So, if you are getting the recovery well, definitely your risk for that particular musculoskeletal injury is less. But if you are not getting recovery period, then small amount is amount of trauma is getting accumulated and that particular trauma will cause the disorder or discomfort in long run. So, here this Fr is the lack of recovery period and Fd is the multiplier factor according to the daily duration of repetitive task.



Now to determine the overall number of RTA that is the recommended technical action within a shift, we need to proceed as this particular method.

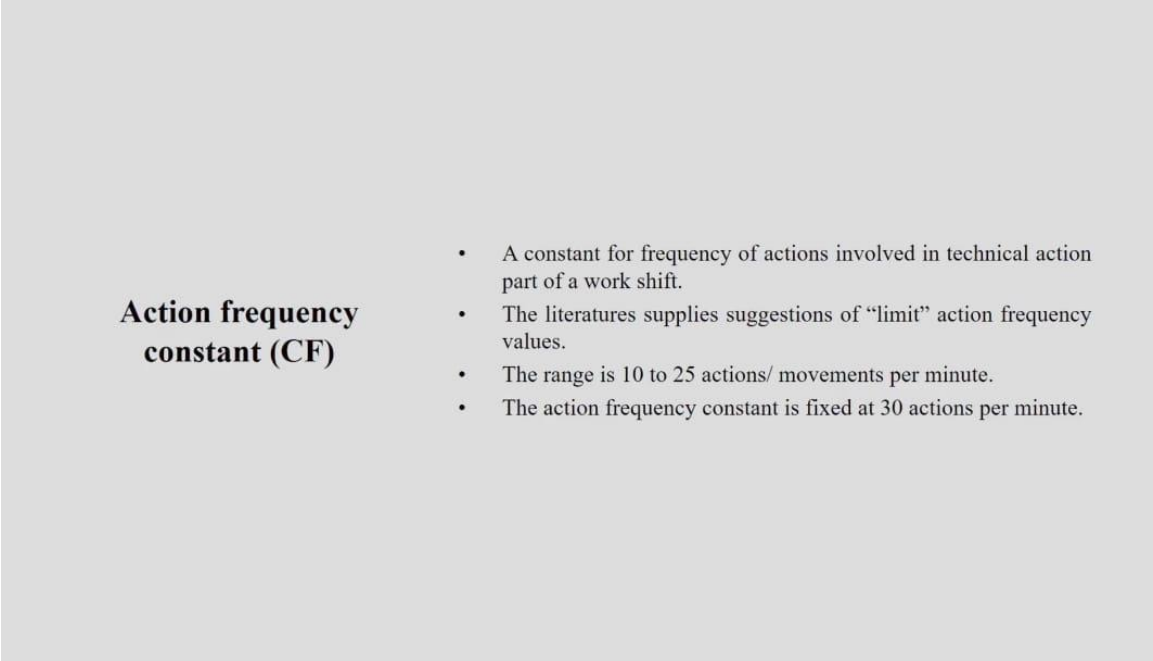
So, these are the steps that you need to proceed through. So, let us understand that. For each repetitive task, start from CF of 30 action per minute. So, that you need to calculate that CF 30 action per minute. For each task, CF must be corrected for the presence and degree of risk factors like force, posture, and additional risk factors.

Then you need to multiply the weighted frequency for each task by number of minute of each repetitive task. So, for each repetitive task, what is the total number of exposure, total number of minute that you need to multiply. Once all these things are there, then you have to sum the values obtained for the different task. So, you have task 1, task 2, task 3, then you have to add them up. The resulting value is multiplied by multiplier factor for recovery period.

Apply the last multiplier factor that consider the total time spent in a particular repetitive task and then the value obtained like once we multiply all these small small elements, then we get the represents the total recommended number of technical action in the

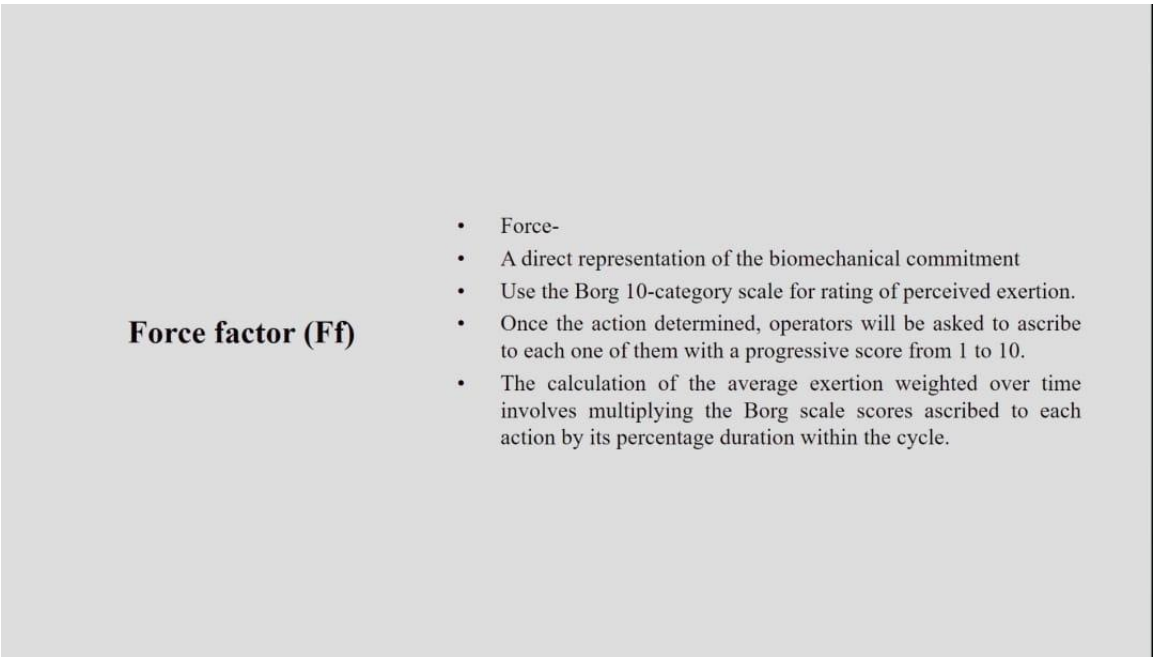
working shift. So, this is the detailed understanding of the previous formula, this particular formula So, this is the process how you should go ahead and compute this particular recommended technical action. So, you have your actual technical action from your video or from your direct observation divided by the recommended technical action, then you get your OCRA risk index. So, if it is higher than 1, definitely it is risky or if it is lower than 1, then it is within a comfortable zone.

So, you are not crossing the recommendation. What is recommended? You are within it, then it is good. If it is more than that, then definitely it is risky.



Now, what is action frequency constant? So, we need to understand each small variable with more detail. So, what it is? A constant for frequency of action involved in technical action part of a work shift. The literature supplies suggestions of limit action frequency values.

The ranges are from 10 to 20 actions per movement per minute. The action frequency constant is fixed at 30 actions per minute. So, that is the recommendation.



Next is force, force factor. So, earlier one was the constant frequency, next is the Ff that is the force factor. So, what it is? A direct representation of biomechanical commitment.

So, when you are your muscles are involved to do some job, definitely there is a force requirement so that that biomechanical representation is done by the factor force. Use the Borg you know 10 CR 10 category scale, category ratio scale for rating the perceived exertion. So, you cannot really measure it. So, you need to ask what is the perception.

So, at which scale this perception is. Once the action determined, operators will be asked to describe the to each one of them with a progressive score from 1 to 0. The calculation of the average exertion weighted over time involves multiplying the Borg scale score ascribed to each action by its percentage duration within the cycle, percentage duration within the cycle. So, you have a Borg scale value multiplied by the percentage duration that is required to complete that particular element in a cycle. So, multiply that, then the force factor is coming. So, you have a Borg scale value, CR 10 scale value multiplied by up to.

So, for that particular technical action, what is the percentage of duration is taken for that particular cycle. So, I am just giving an example. Suppose your total cycle time is 3 minute ok and for this particular technical action is continuing for 30 seconds. So, the percentage is 30 divided by 3 into 60 multiplied by 100. So, then that percentage you need to multiply with the that particular value you need to multiply with your Borg scale, Borg's value.

So, then the value comes for the force factor you know this is one factor.

Postural factor (Pf)

- The assessment of the posture must be done over a representative cycle for each one of the repetitive tasks examined.
- This must be via the description of duration of the postures and/ or movements of the four main anatomical segments (both right and left):
  - Shoulder, wrist, elbow, hand
- Within the execution of every action, the joint segment involved reaches and excursion greater than 50% of joint range for at least 1/3rd of the cycle time.
- The longer the time, the higher is the score.
- The presence of stereotypical movements can be pinpointed by observing those technical actions that are all equal to each other for at least 50% of cycle time or by a very short duration of the cycle.
- All of these elements together lead to design of a useful scheme to identify the values of the posture multiplier factor (Fp).

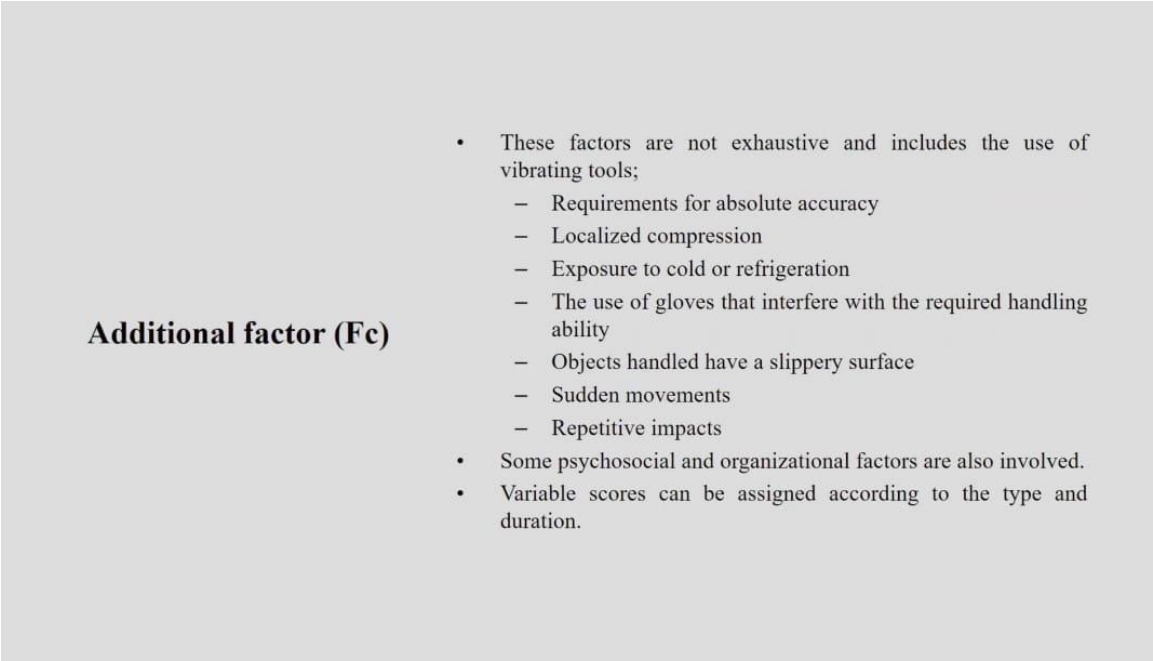
The next is your postural factor. What it is? The assessment of posture must be done over a representative cycle of course, every measurement that we are doing we are doing for the representative cycle. So, for a representative cycle for each one of the repetitive task which is being examined. So, this must be via the description of duration of the posture and or movement of the four anatomical segment both right and left may be.

So, shoulder, wrist, elbow, and hand. So, what is the posture of these parts like these upper extremities. Within the execution of every action the joint segment involved where it is reaching and excursion greater than 50 percent of the joint range for at least one-third of the cycle time. So, how you are calculating? So, suppose I am just taking an example you have a range of motion of your elbow joint Now, you have to see that this particular elbow joint that particular movement for 50 percent of that whole range. Suppose it is it has a range it has a range maybe this is the range of that particular person's elbow joint.

Now this is the whole range. Now it is crossing a range of more than 50 percent and this particular thing is being like you know is being continued for at least one-third of the cycle time. So, that is the value. So, the longer the time is the higher the value is or score is. So, if it is very common understanding that if you are away from the normal range for longer duration definitely you are going to get more struggle to hold that particular posture. Here also we are hold going for the same concept that if a joint range is holding more than 50 percent that particular range for one-third time of the whole cycle time then you need to consider it or you need to take it as a value.

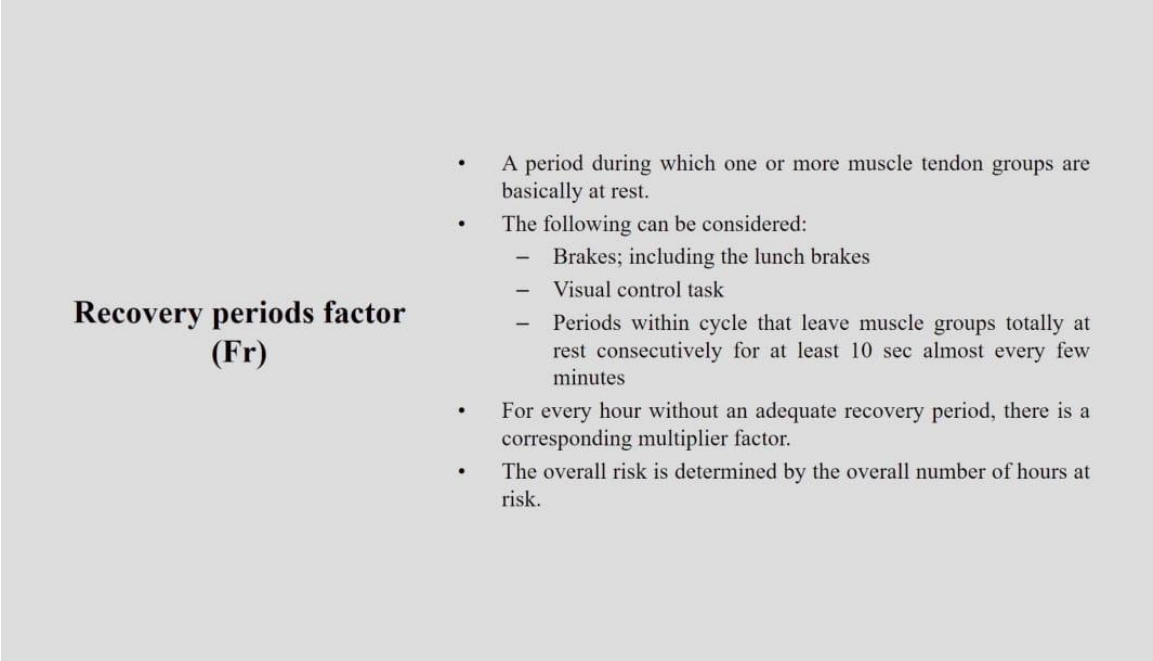
So, the percentage of stereotypical movement can be pinpointed by observing those tactical actions that are all equal to each other for at least 50 percent of the cycle time or

by a very short duration of the cycle time. So, this consideration you need to do when we are talking about the postural factor. So, all of these elements together lead to design of a useful scheme to identify the values of the postural multiplier factor that is the Fp.



Moving forward that is the additional factor what these are. So, these factors are not exhaustive and includes the use of the vibrating tool.

What these are? Use of absolute accuracy, localized compression, exposure to cold or refrigeration, the use of gloves that interfere the required handling ability because if you are only wearing some kind of gloves and you are doing some job definitely it is going to restrict the whole movement. Objects handled have a slippery surface, sudden movement, repetitive impacts, etc. Some psychosocial and organizational factors are also involved. Now this part is like is varied, it keeps on changing. Variable scores can be assigned according to the type and the duration.



Now, next is your recovery period factor. This is very important factor. So, a period during which one or more muscle-tendon groups are basically at rest, the following can be considered by breaks including lunch break, visual control task, period within cycle that leave muscle groups totally at rest consecutively for at least 10 seconds almost every few minutes. So, all these cases so, where you are going to get some recovery.

So, during your lunch break your muscles are in not doing anything. So, some you are doing some kind of visual task, you are just reading, you are some inspecting. So, maybe those time during that particular period your upper extremities are not working then also it is in rest. Also some cases where every short duration you are getting some break. So, everything we will be considering as the recovery period. So, for every hour without an adequate recovery period there is a corresponding multiplier factor.

So, for each case, you have a corresponding multiplier factor. The overall risk is determined by the overall number of hours at risk. So, the overall risk you need to determine from the overall number of hours at risk.

Calculation of OCRA exposure

- Table 1 provides the necessary parameters for dealing with all of the multiplier factors and calculating the OCRA index.
- These results provide the basis for suggesting recommended technical actions in accord with the OCRA index.

So, calculation of the OCRA exposure. So, we have a table so, that I am going to show now. So, that particular table provides the necessary parameter for dealing with all the multiplier factors and calculating the OCRA index.

These results provide the basis of struggling method, struggling recommended technical action in accordance with the OCRA index.

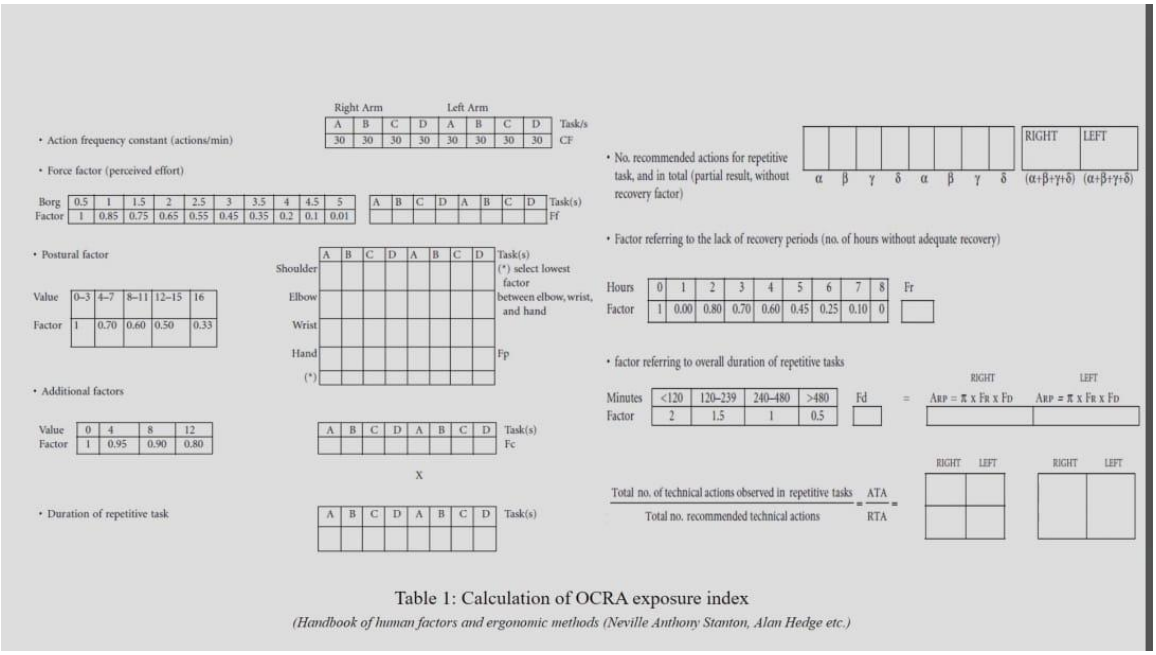


Table 1: Calculation of OCRA exposure index

(Handbook of human factors and ergonomic methods (Neville Anthony Stanton, Alan Hedge etc.)

So, let us understand this factor very clearly. Now how these are the action frequency constant. So, you have for right term, you have for left term.

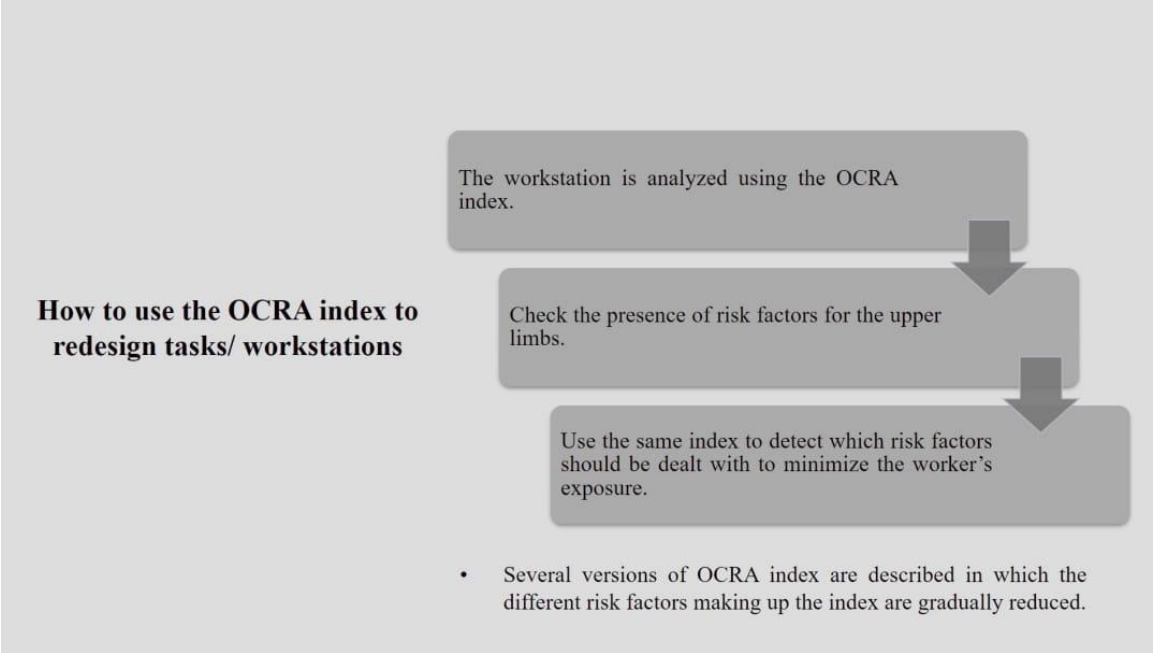
So, A, B, C, and D that means your parts. Now force factor it is a perceived effort from the box this box CR 10 scale you will get all these pre-computed value. So, from here you can see for A what is B, what is C, what is D, what is this is for right and this is for left. Then you will get the calculation of F, F that is the force factor. Coming to postural value.

So, this is these are the values and these are the factors corresponding factors. So, for shoulder, for elbow, for wrist and hand, this is for your right, this is for your left. So, you can give these value and you can calculate the F p. Now additional factors similarly 0, 4, 8. So, scale value and then these the multiplier, and here also you get this particular thing is this the Fc.

Now duration of repetitive task you can have the duration over here. Now number of recommended actions for repetitive task in a in total. So, partial result without recovery factor that you need to do this alpha, beta, gamma, delta for right and this is for your left. So, you can have both the things for left and right. Now here is the hour's calculation and the minute like duration total duration.

So, that is the recovery here and this is the Fd. Once you get all these thing, then you can have this value that is the total number of action observed in repetitive task. So, that you are going to calculate from the actual video and the recommendation you will get from all these tables ok and you get this particular value and then you get this ATA divided by RTA that is the OCRA index OCRA index for right and OCRA index for left So, once you get all these detail if you want to go into more detail about this particular tool and the calculation you can refer this book or you can go to the original paper of this particular tool, then you can get more detailed calculation. Due to constrain of the time we may not go into further discussion about this calculation, we can do it in the discussion forum.

So, this way you can calculate the OCRA index fine.



Now how to use this index? We calculated. Now what next? So how to use the OCRA index to redesign the task or the workstation? So as I mentioned it is if it is more than one definitely it is risky, if it is equal to or less than one then if it is acceptable. So, the workstation is analyzed using the OCRA index, check the presence of risk factors for the upper limb. Now if you see that OCRA index is higher then definitely there is a risk. Now you have to go back and check each factor and you have to see why these shoulder, upper arm, then elbow, wrist how these things are getting exposed to some kind of risk. So that checking you have to do for the upper limb and use the same index to detect the risk factor what you need to deal with to minimize the worker's exposure.

Now once you do the intervention then what you need to do? You have before OCRA index for set of people for set of job and you have after OCRA like after intervention the OCRA index set of people and for the set of job then you can definitely have a comparison. You can use any kind of statistical test which is suitable I would suggest go for the PRT test probably it will help you to understand these values and maybe you can have some more test which is suitable to such kind of cases and you can do the comparison saying that your intervention is effective or not effective. So if OCRA index significantly effective or not effective OCRA index may be reduced for need to be reduced so that you see the improvisation. So that way we use the OCRA index. So, several version of OCRA index are described in which the different risk factors making up the index are gradually reducing.

So that way you can so maybe do the first version, second version, third version like that you keep on working it till you are not satisfied.

Right Limb	Actions/min	Actions/Shift	Force	Posture	Recovery Periods	OCRA Index
A	53.3	18,144	0.9	0.6	0.6	6.1
B	63.7		0.9	0.5		
A	45	14,472	0.9	0.6	0.6	4.9
B	45		0.9	0.5		
A	53.3	18,144	1	0.6	0.6	5.5
B	63.7		1	0.5		
A	53.3	18,144	0.9	0.6	0.8	4.5
B	63.7		0.9	0.5		
A	53.3	18,144	1	0.6	0.8	4.1
B	63.7		1	0.5		
A	45	14,472	1	0.6	0.8	3.3
B	45		1	0.5		
A	45	14,472	1	0.7	1	2.1
B	45		1	0.7		

Left Limb	Actions/min	Actions/Shift	Force	Posture	Recovery Periods	OCRA Index
A	40	12,864	0.8	0.5	0.6	5.4
B	40		0.9	0.5		
A	35	11,256	0.8	0.5	0.6	4.7
B	35		0.9	0.5		
A	40	12,864	1	0.5	0.6	4.4
B	40		1	0.5		
A	40	12,864	0.8	0.5	0.8	4
B	40		0.9	0.5		
A	40	12,864	1	0.5	0.8	3.3
B	40		1	0.5		
A	35	11,256	1	0.5	0.6	2.9
B	35		1	0.5		
A	35	11,256	1	0.7	1	1.7
B	35		1	0.7		

Progressive optimization of Task using the OCRA index

(Handbook of human factors and ergonomic methods (Neville Anthony Stanton, Alan Hedge etc.)

- These tables propose a summary of the OCRA indexes in which the optimization of each individual factor or set of factors are shown.
- The initial OCRA value = 6.1 for the right and 5.4 for the left.
- The job being analyzed comprises two alternative tasks (A & B) featuring: task A = 53.3 actions/ min and task B = 63.7 actions/ min. Both are them for right.
- After reducing action frequency, task A = 45 actions/ min and task B = 45 actions/ min for the right and for left, 35 actions/ min for both.
- Total number of actions/ shift for right is reduced from 18,144 to 14,472 and 12,864 to 11,256 for left.

So, this is the kind of progressive optimization task using OCRA you can read through it I will highlight some major point. So, these tables propose a summary of OCRA index indices in which the optimization of each individual factor or set of factors are shown so that you can see how posture, how force, and all these things are improving.

The initial OCRA value was 6.1 for the right hand and 5.4 for the left hand and job being analyzed comprises two alternative tasks that is A and B featuring task A is equal to 53.3 actions per minute and B is 63.7 actions per minute. So, both of them were for the right hand and after reducing the action frequency A is reduced to 45 and B is 45. So, both cases it became 45 actions per minute and minute for right and for left 35 actions per minute for both cases for A and for B.

So total number of actions per shift for right hand reduced from 18,144 to 14,472. So, this also is reduced. So that way it shows there is an improvement.

How to use the OCRA index to redesign tasks/ workstations

- Introducing a reduction in the use of force,
  - The OCRA index for right = 5.5
  - The OCRA index for left = 4.4
- It is also possible to recalculate the OCRA index when nothing but the distribution of the recovery periods is optimized.
- By optimizing two factors simultaneously (use of force and distribution of recovery times)
  - The OCRA index for right = 4.1
  - The OCRA index for left = 3.3
- If three variables are optimized (with a reduction in the action frequency)
  - The OCRA index for right = 3.3
  - The OCRA index for left = 2.9

So how do we use it for your redesigning? So, introducing a reduction in the use of force the OCRA index for right was 5.5, and OCRA index for left was 4.4. It is also to recalculate the OCRA index when nothing but the distribution of recovery time, recovery period is optimized. So, recovery period that if you are redistributing, rearranging once you are doing that, or then only the optimization can be done. So, anyway, we always say we cannot make it 0, any risk we cannot make it 0, we just can do the optimization.

So, by optimizing two factors simultaneously the OCRA index reduced to 4.1 and 3.1 for right and left respectively, and if three variables are optimized then maybe it can come down 3.3 and 2.2. Now here is a concern that how you do it.

It is not always a scope of your research that you can handle all three influencing factors. It is sometime possible only one factor or sometimes it is possible all three factors So depending on the situation, depending on your research objectives, depending on the available resources you should see which is possible and how do you take it further.

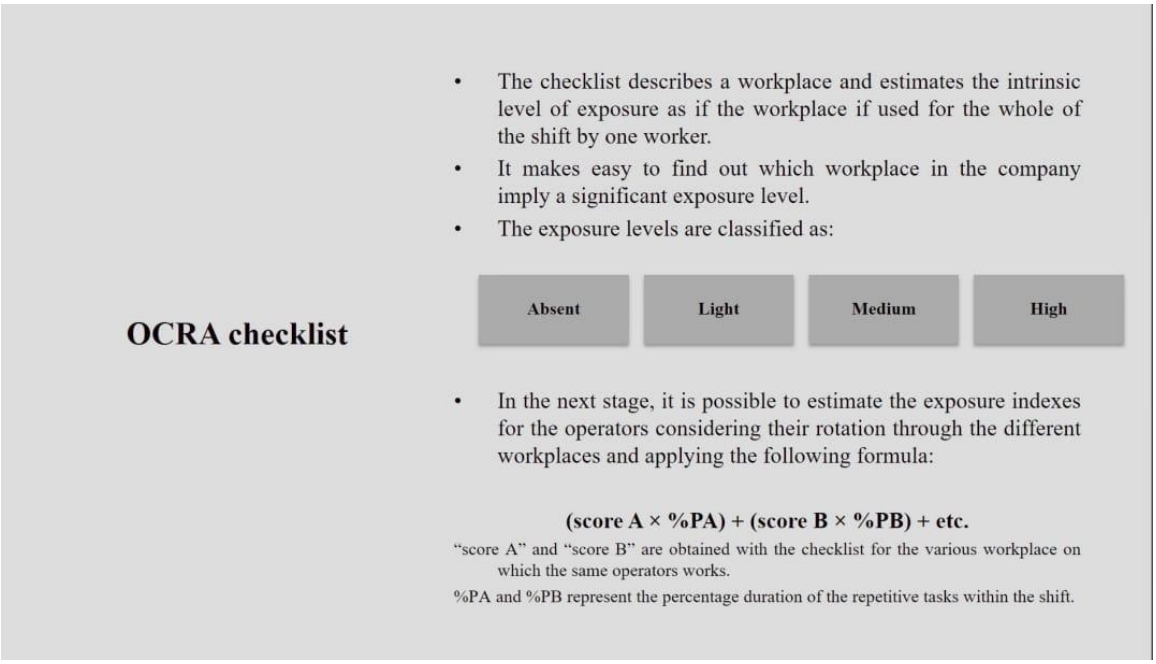
Classification of OCRA index results

- By considering the trend of UE WMSDs in reference to working populations that are not exposed to specific occupational risks

Index values	Definition	Area
≤ 1.5	Risk absent	Green
1.6 – 2.2	Not relevant risk	Green/ yellow
2.3 – 3.5	Very low risk	Yellow/ red
≥ 3.6 – 9.0	Medium risk	Red
≥ 9.1	High risk	Red

So, classification, so what it says? Now it has a classification of this OCRA index value by considering the trend of upper extremity work-related musculoskeletal disorder in reference to the working population that are not exposed to specific occupational risk this calculation has been done.

It says that if it is less than equal to 1.5 the risk is absent, so it is green, 1.6 to 2.2 not relevant risk green or yellow, and slowly it is increasing and it says if it is more than 9.1 then definitely it is very very high risk. So, this is quite similar but so you cannot expect something go more than this.



Now coming to the OCRA checklist. So, once we have OCRA index then we go for the OCRA checklist. Now let us understand OCRA checklist. So, from OCRA index only we can have this value OCRA checklist. This particular checklist describes our workplace and estimate the intrinsic level of exposure as if the workplace if used for a whole of a shift by one worker. It makes easy to find out which workplace in the company imply a significant exposure level.

So, it try to enquire which is going to give more problem. So, the exposure levels are classified as absent, lightly present, moderate present or medium, and high. So, in the next stage, it is possible to estimate the exposure index or indices for the operators considering their rotation through the different workplaces and applying the following formula what it is. So, score A multiplied by percentage of PA. Now what is the plus score B into percentage of PB and continue. So, score A and score B are obtained with the checklist for various workplace on which the same operators work and percentage of PA and PB represents the percentage duration.

So, as I mentioned always in OCRA you know duration of exposure is very important. So, percentage of duration of the repetitive task in that particular shift.

TYPE OF WORK INTERRUPTION (WITH PAUSES OR OTHER VISUAL CONTROL TASKS) Choose one answer. It is possible to choose intermediate values.

0 - THERE IS AN INTERRUPTION OF AT LEAST 5 MINUTES EVERY HOUR IN THE REPETITIVE WORK (ALSO COUNT THE LUNCH BREAK).
1 - THERE ARE TWO INTERRUPTIONS IN THE MORNING AND TWO IN THE AFTERNOON (PLUS THE LUNCH BREAK), LASTING AT LEAST 7–10 MINUTES ON THE 7–8 HOUR SHIFT, OR AT LEAST FOUR INTERRUPTIONS PER SHIFT (PLUS THE LUNCH BREAK), OR FOUR 7–10 MINUTE INTERRUPTIONS IN THE 6-HOUR SHIFT.
3 - THERE ARE TWO PAUSES, LASTING AT LEAST 7–10 MINUTES EACH IN THE 6-HOUR SHIFT (WITHOUT LUNCH BREAK); OR, THREE PAUSES, PLUS THE LUNCH BREAK, IN A 7–8-HOUR SHIFT.
4 - THERE ARE TWO PAUSES, PLUS THE LUNCH BREAK, LASTING AT LEAST 7–10 MINUTES EACH OVER A 7–8 HOUR SHIFT (OR THREE PAUSES WITHOUT THE LUNCH BREAK), OR ONE PAUSE OF AT LEAST 7–10 MINUTES OVER A 6-HOUR SHIFT.
6 - THERE IS A SINGLE PAUSE, LASTING AT LEAST 10 MINUTES, IN A 7-HOUR SHIFT WITHOUT LUNCH BREAK; OR, IN AN 8-HOUR SHIFT THERE ONLY IS A LUNCH BREAK (THE LUNCH BREAK IS NOT COUNTED AMONG THE WORKING HOURS).
10 - THERE ARE NO REAL PAUSES EXCEPT FOR A FEW MINUTES (LESS THAN 5) IN A 7–8-HOUR SHIFT.

ARM ACTIVITY AND WORKING FREQUENCY WITH WHICH THE CYCLES ARE PERFORMED (IF NECESSARY, INTERMEDIATE SCORES CAN BE CHOSEN) Choose one answer (state whether left or right arm is involved the most).

0 - ARM MOVEMENTS ARE SLOW, AND FREQUENT SHORT INTERRUPTIONS ARE POSSIBLE (20 ACTIONS PER MINUTE).
1 - ARM MOVEMENTS ARE NOT TOO FAST, ARE CONSTANT AND REGULAR. SHORT INTERRUPTIONS ARE POSSIBLE (30 ACTIONS PER MINUTE).
3 - ARM MOVEMENTS ARE QUITE FAST AND REGULAR (ABOUT 40), BUT SHORT INTERRUPTIONS ARE POSSIBLE.
4 - ARM MOVEMENTS ARE QUITE FAST AND REGULAR, ONLY OCCASIONAL AND IRREGULAR SHORT PAUSES ARE POSSIBLE (ABOUT 40 ACTIONS PER MINUTE).
6 - ARM MOVEMENTS ARE FAST. ONLY OCCASIONAL AND IRREGULAR SHORT PAUSES ARE POSSIBLE (ABOUT 50 ACTIONS PER MINUTE).
8 - ARM MOVEMENTS ARE VERY FAST. THE LACK OF INTERRUPTIONS IN PACE MAKES IT DIFFICULT TO HOLD THE PACE, WHICH IS ABOUT 60 ACTIONS PER MINUTE.
10 - VERY HIGH FREQUENCIES, 70 ACTIONS PER MINUTE OR MORE. ABSOLUTELY NO INTERRUPTIONS ARE POSSIBLE

THIS WORKING TASK IMPLIES:

☐ THE HANDLING OF OBJECTS WEIGHING OVER 3 KG
☐ GRIPPING BETWEEN FOREFINGER AND THUMB AND LIFTING OBJECTS WEIGHING OVER 1 KG (IN PINCH)
☐ USING THE WEIGHT OF THE BODY TO OBTAIN THE NECESSARY FORCE TO CARRY OUT A WORKING ACTION
☐ THE HANDS ARE USED AS TOOLS TO HIT OR STRIKE SOMETHING

1 - ONCE EVERY FEW CYCLES
2 - ONCE EVERY CYCLE
4 - ABOUT HALF OF THE CYCLE
8 - FOR OVER HALF OF THE CYCLE

THE WORKING ACTIVITY REQUIRES THE USE OF INTENSE FORCE FOR:
☐ PULLING OR PUSHING LEVERS
☐ PUSHING BUTTONS
☐ CLOSING OR OPENING
☐ PRESSING OR HANDLING COMPONENTS
☐ USING TOOLS

4 - 1/3 OF THE TIME
6 - ABOUT HALF OF THE TIME
8 - OVER HALF OF THE TIME (*)
16 - NEARLY ALL THE TIME (*)

THE WORKING ACTIVITY REQUIRES THE USE OF MODERATE FORCE FOR:
☐ PULLING OR PUSHING LEVERS
☐ PUSHING BUTTONS
☐ CLOSING OR OPENING
☐ PRESSING OR HANDLING COMPONENTS
☐ USING TOOLS

2 - 1/3 OF THE TIME
4 - ABOUT HALF OF THE TIME
6 - OVER HALF OF THE TIME
8 - NEARLY ALL THE TIME

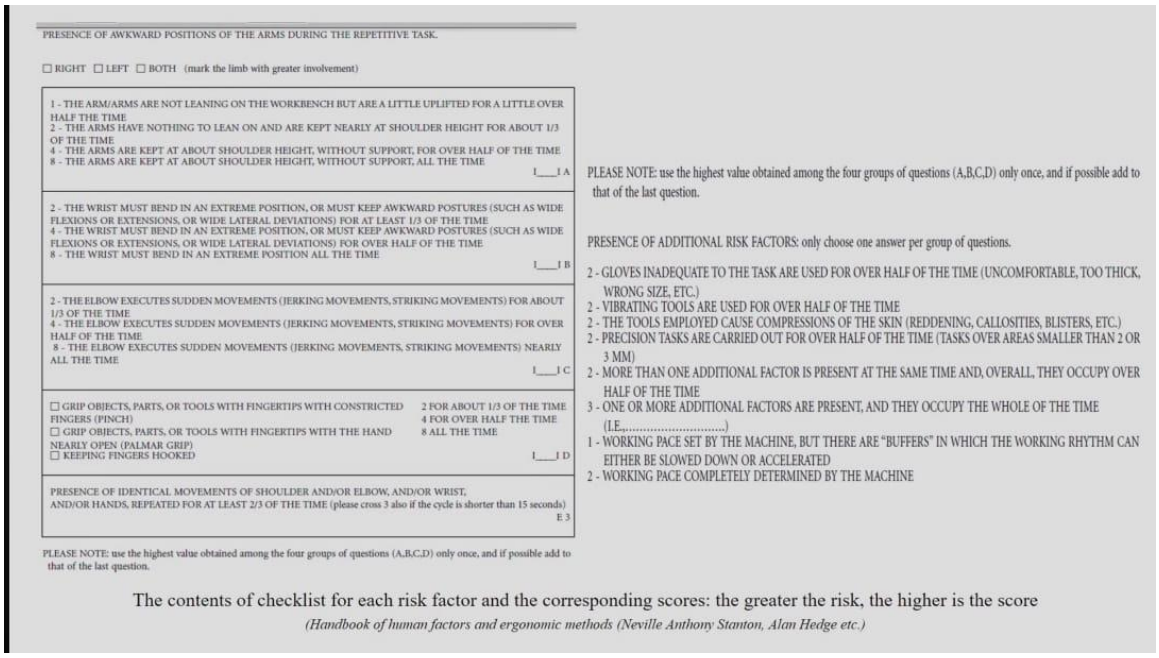
The contents of checklist for each risk factor and the corresponding scores: the greater the risk, the higher is the score

(Handbook of human factors and ergonomic methods (Neville Anthony Stanton, Alan Hedge etc.)

So, this is the formula that we use and this is the you know content of the checklist for each risk factors and the corresponding scores. So, the greater the risk higher the score value. So let us understand this.

You can read it out because it is very difficult in this particular forum to read all these questions. So, I suggest you refer this particular handbook or maybe you can download it from original paper to get this checklist and read it out. If you have any difficulties to understand this particular checklist maybe later we can discuss it. So, everything is mentioned very detail in a detailed manner.

So how you take this as a simple checklist.



PRESENCE OF AWKWARD POSITIONS OF THE ARMS DURING THE REPETITIVE TASK.

☐ RIGHT ☐ LEFT ☐ BOTH (mark the limb with greater involvement)

1 - THE ARM/ARMS ARE NOT LEANING ON THE WORKBENCH BUT ARE A LITTLE UPLIFTED FOR A LITTLE OVER HALF THE TIME
2 - THE ARMS HAVE NOTHING TO LEAN ON AND ARE KEPT NEARLY AT SHOULDER HEIGHT FOR ABOUT 1/3 OF THE TIME
4 - THE ARMS ARE KEPT AT ABOUT SHOULDER HEIGHT, WITHOUT SUPPORT, FOR OVER HALF OF THE TIME
8 - THE ARMS ARE KEPT AT ABOUT SHOULDER HEIGHT, WITHOUT SUPPORT, ALL THE TIME
I____I A

2 - THE WRIST MUST BEND IN AN EXTREME POSITION, OR MUST KEEP AWKWARD POSTURES (SUCH AS WIDE FLEXIONS OR EXTENSIONS, OR WIDE LATERAL DEVIATIONS) FOR AT LEAST 1/3 OF THE TIME
4 - THE WRIST MUST BEND IN AN EXTREME POSITION, OR MUST KEEP AWKWARD POSTURES (SUCH AS WIDE FLEXIONS OR EXTENSIONS, OR WIDE LATERAL DEVIATIONS) FOR OVER HALF OF THE TIME
8 - THE WRIST MUST BEND IN AN EXTREME POSITION ALL THE TIME
I____I B

2 - THE ELBOW EXECUTES SUDDEN MOVEMENTS (JERKING MOVEMENTS, STRIKING MOVEMENTS) FOR ABOUT 1/3 OF THE TIME
4 - THE ELBOW EXECUTES SUDDEN MOVEMENTS (JERKING MOVEMENTS, STRIKING MOVEMENTS) FOR OVER HALF OF THE TIME
8 - THE ELBOW EXECUTES SUDDEN MOVEMENTS (JERKING MOVEMENTS, STRIKING MOVEMENTS) NEARLY ALL THE TIME
I____I C

☐ GRIP OBJECTS, PARTS, OR TOOLS WITH FINGERTIPS WITH CONSTRICTED FINGERS (PINCH)
☐ GRIP OBJECTS, PARTS, OR TOOLS WITH FINGERTIPS WITH THE HAND NEARLY OPEN (PALMAR GRIP)
☐ KEEPING FINGERS HOOKED
2 FOR ABOUT 1/3 OF THE TIME
4 FOR OVER HALF THE TIME
8 ALL THE TIME
I____I D

PRESENCE OF IDENTICAL MOVEMENTS OF SHOULDER AND/OR ELBOW, AND/OR WRIST, AND/OR HANDS, REPEATED FOR AT LEAST 2/3 OF THE TIME (please cross 3 also if the cycle is shorter than 15 seconds)
E 3

PLEASE NOTE: use the highest value obtained among the four groups of questions (A,B,C,D) only once, and if possible add to that of the last question.

PLEASE NOTE: use the highest value obtained among the four groups of questions (A,B,C,D) only once, and if possible add to that of the last question.

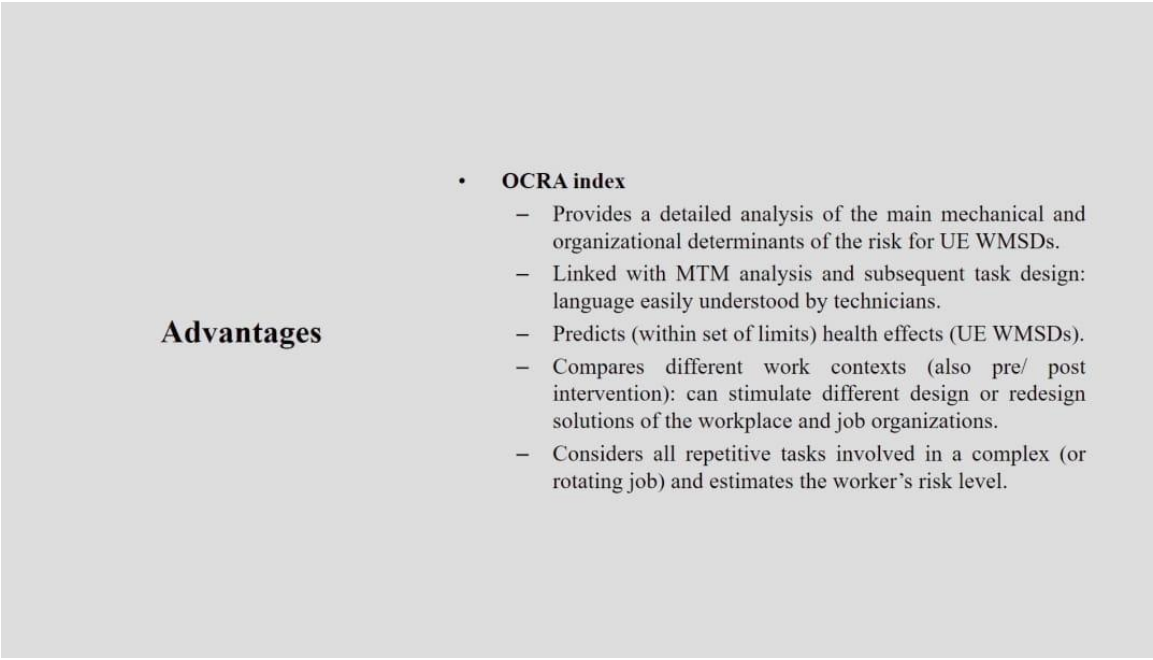
PRESENCE OF ADDITIONAL RISK FACTORS: only choose one answer per group of questions.

2 - GLOVES INADEQUATE TO THE TASK ARE USED FOR OVER HALF OF THE TIME (UNCOMFORTABLE, TOO THICK, WRONG SIZE, ETC.)
2 - VIBRATING TOOLS ARE USED FOR OVER HALF OF THE TIME
2 - THE TOOLS EMPLOYED CAUSE COMPRESSIONS OF THE SKIN (REDDENING, CALLOSITIES, BLISTERS, ETC.)
2 - PRECISION TASKS ARE CARRIED OUT FOR OVER HALF OF THE TIME (TASKS OVER AREAS SMALLER THAN 2 OR 3 MM)
2 - MORE THAN ONE ADDITIONAL FACTOR IS PRESENT AT THE SAME TIME AND, OVERALL, THEY OCCUPY OVER HALF OF THE TIME
3 - ONE OR MORE ADDITIONAL FACTORS ARE PRESENT, AND THEY OCCUPY THE WHOLE OF THE TIME (I.E.....)
1 - WORKING PACE SET BY THE MACHINE, BUT THERE ARE "BUFFERS" IN WHICH THE WORKING RHYTHM CAN EITHER BE SLOWED DOWN OR ACCELERATED
2 - WORKING PACE COMPLETELY DETERMINED BY THE MACHINE

The contents of checklist for each risk factor and the corresponding scores: the greater the risk, the higher is the score

(Handbook of human factors and ergonomic methods (Neville Anthony Stanton, Alan Hedge etc.)

So, this is the whole content.



Advantages

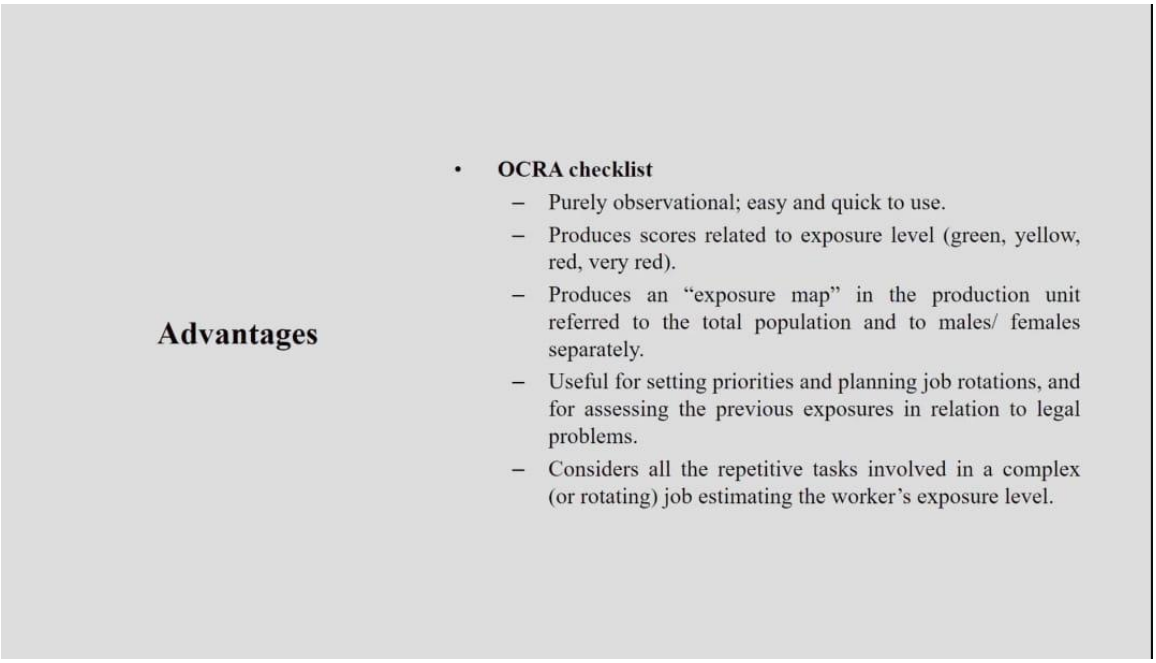
- **OCRA index**
  - Provides a detailed analysis of the main mechanical and organizational determinants of the risk for UE WMSDs.
  - Linked with MTM analysis and subsequent task design: language easily understood by technicians.
  - Predicts (within set of limits) health effects (UE WMSDs).
  - Compares different work contexts (also pre/ post intervention): can stimulate different design or redesign solutions of the workplace and job organizations.
  - Considers all repetitive tasks involved in a complex (or rotating job) and estimates the worker's risk level.

Now let us understand what are the advantages of OCRA index. So, it this particular index provides a detailed analysis of main mechanical and organizational determinants of the risk of upper extremity work-related musculoskeletal disorder. So, both mechanical and organizational factors. It is linked with your MTM analysis motion time measurement analysis and subsequent task design language is very easily you know understood by the technician. So anyone who has basic idea of musculoskeletal disorders,

basic risk factors of musculoskeletal disorders, any kind of time study, and motion study they can easily understand this particular tool and they can perform it.

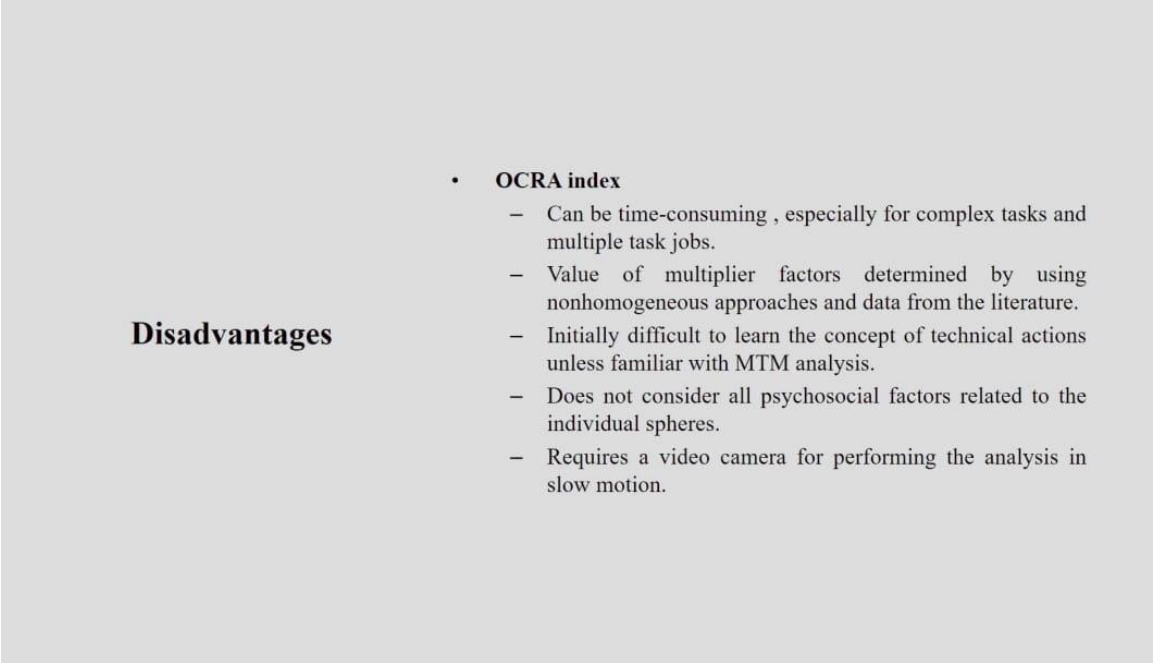
It predicts the health effect on upper extremity musculoskeletal disorder within a set of limit. It compares different work context can stimulate different design or redesign solution of the workplace and job organization. This is very important. You can say this is better than this and this is better than that. So that way you can have lot of comparison and you can choose the best out of any particular design. So maybe for a single solution, you have four variant, four varieties of design, and using this particular OCRA you can choose any one of them which is giving best result to have a better upper extremity musculoskeletal health.

Consider all repetitive task which is involved in a complex and estimate the worker's risk level. So, these are the advantages for the OCRA index.



However, there are some disadvantages. Some more advantages it is purely observational and easy and quick to use. It also provides course related to exposure level like green, yellow, red and very red and produces an exposure map in the production unit referred to the total population and to male and female separately.

Useful for setting priorities and planning the job rotation. Of course, if you see that this particular cycle is getting more repetitive and it is going to cause lot of trouble then what you can do you can have some kind of job rotation of here and you can set the recovery time so that there is less exposure towards the duration of exposure. So, consider all the repetitive task involved in a complex job estimating the worker's exposure level. So, these are the advantages.



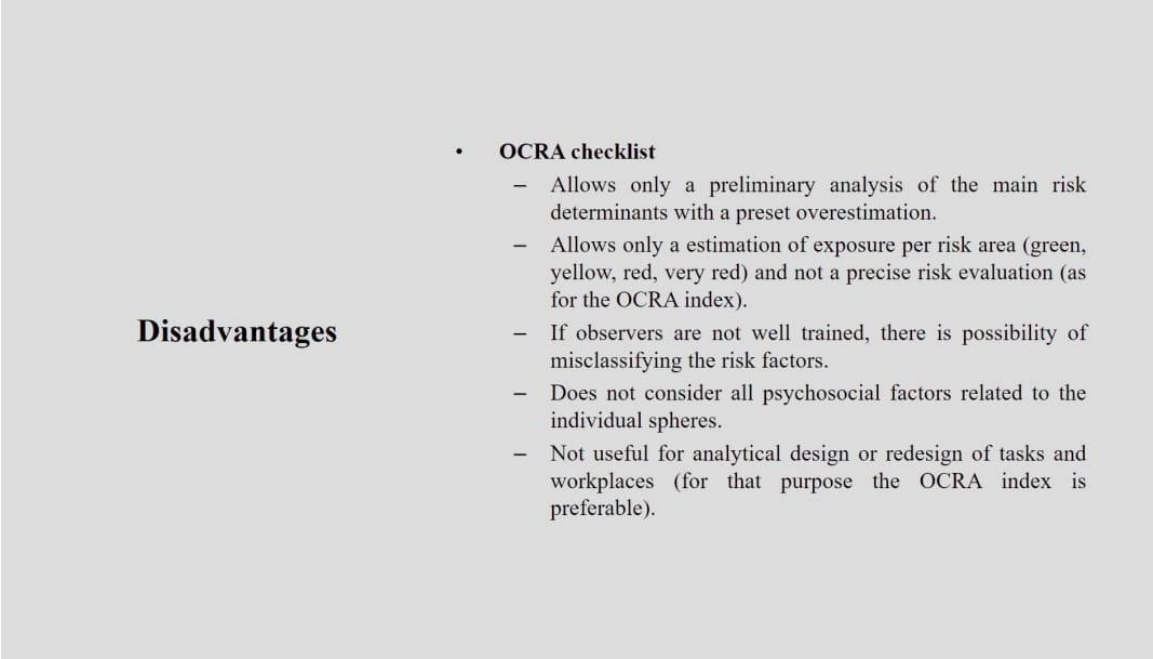
Disadvantages so can be time-consuming you can understand for each factor FR, FP, and FC for each cases you have you need lot of time to calculate those values, and observation period also it is quite longer.

So can be time-consuming, especially for complex task and multiple task job it takes lot of time to understand the task. First is the definition of the action. Technical action you have to define starting point, ending point. Maybe pinpointing those seconds are very important. So, it is a tedious job as well.

So, value of multiplier factors determined by using non-homogeneous approaches and data from the literature. So, this is little tough part, and initially difficult to learn the concept of technical action. So, who are very much familiar with the motion study, time study like time measurement, motion measurement for them maybe it is easy but those people who are not exposed towards such kind of study for them understanding the technical actions are little difficult. So that is difficult.

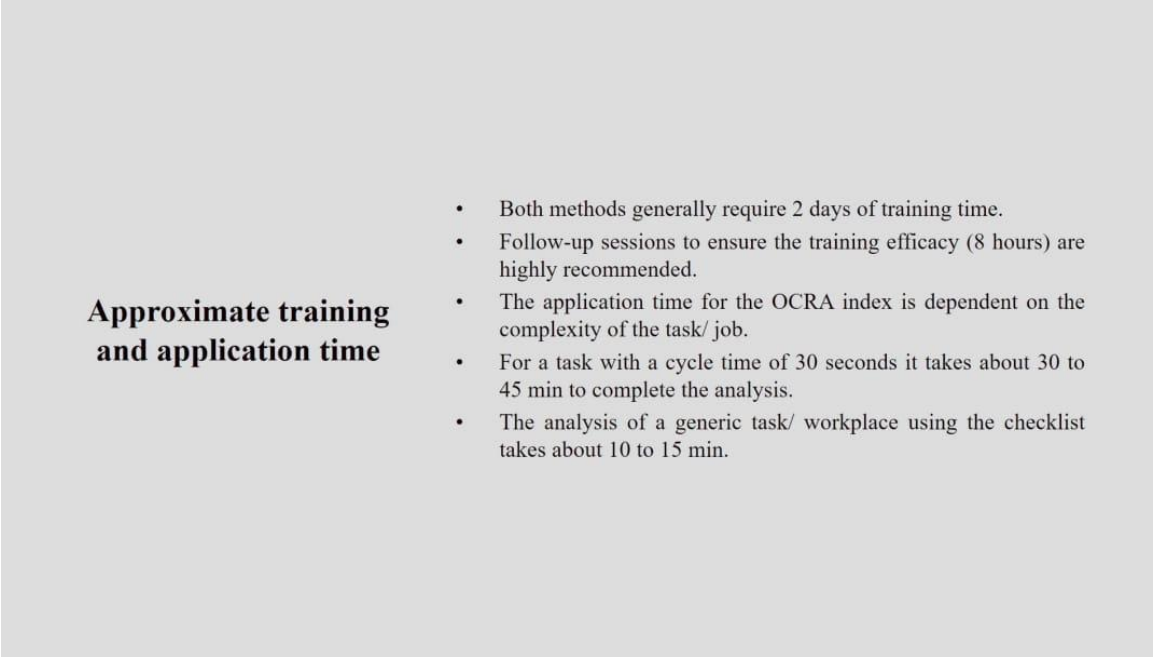
So, you have to have a prior knowledge of MTM otherwise you will not be able to do it. Does not consider all psychosocial factors. It is not considering all psychosocial factors very few related to the individual sphere. It requires a video camera for performing the analysis in a slow motion because you are talking about technical action. Technical action when it is in a full speed you will not be able to separate out at which second it is starting and which second it is ending. So, for that, you need to have a good camera like recording video recording system. You should have an option to start, pause, resume and all these options very clearly so that you can differentiate the action 1, action 2 and action 3, and so on.

So these are some the requirements and these are some kind of disadvantages for this particular tool.



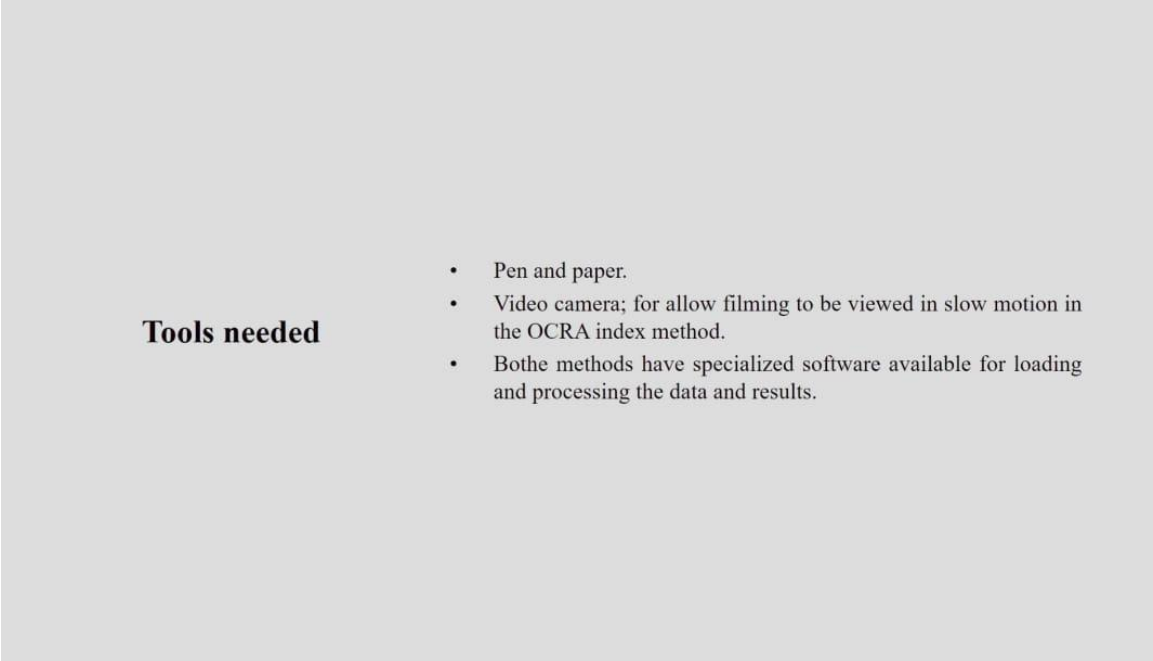
It allows only a preliminary analysis of the main risk determination with a present overestimation, allows only an estimation of exposure per risk area, and not a precise risk evaluation. So, it is just a gross evaluation. If observers are not well trained there is a possibility of misclassifying the risk factors. So, as I mentioned you need to have a good understanding about ergonomics, time measurement, motion measurement, and such related other tools like Borgs scale and all other tools.

Does not consider the psychophysical factors as I mentioned earlier, not useful for analytical design or redesign of task of workplaces. So, if it is analytical in nature probably this will may not be a helpful tool for your case. So, training period, both methods generally requires 2 days of training time, it is an estimation. It is not fixed. So, it depends what is the training intensity.



Follow-up sessions to ensure the training efficacy because it may happen that while training you understood and while actually implementing there is some you know confusion generates so confusion comes.

So maybe they can have some kind of refreshment. The application time of OCRA index is dependent on the complexity of the task and job and for a task with a cycle time of 30 seconds, it takes about 30 to 45 minutes to complete that particular analysis. The analysis of a generic task or the workplace using the checklist it takes about 10 to 15 minutes. But this is completely a generic guideline, it is not absolute. So, I suggest before you go for actual data collection using this OCRA checklist or OCRA index you first practice it with some kind of pilot data. Once you are habituated with all these variables specifically fc, fr, fp and so on then it will be very easy for you to gather information and do the data collection with less time span.



What do you need? You need pen and paper, video camera for which will allow you to have a very good recording, clear recording of each technical actions which is important and both methods have specialized software available for loading and processing the data and results. You can buy that one separately. I do not have any specific information who are the seller of it.

Maybe you can you need to search it and you need to get. We may have some kind of discussion or help at the discussion forum. But right now I will not be able to tell you who what are what is the name of these software's but this is available in the market. You can buy it and use it ok which will enhance the process of analysis partially.

That is all for OCRA. So, what I suggest this is little tricky tool. This is little time-consuming tool. So, everyone should practice OCRA index and OCRA checklist for your own scenario. And once you because computation of OCRA index is little tough. So once you do that then only you will have more query, more you know questioning about that particular part and you can ask it before you complete this particular course. I suggest that you learn this particular tool in detail.

This is very important and useful and you know good tool for upper extremity musculoskeletal disorder. That is all for OCRA index and OCRA checklist.