

**Human Factors Engineering**  
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**Lecture - 55**  
**Major Ergonomic Issues and Problems in Shift Work Design: Part - 2**

Welcome back participants and the students and all the practitioners who are involved in this. For my next part of the lecture which I have designed for the shift work and let us see through the various examples and slides.

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**Circadian Rhythm**

- Human body follows a rhythm of 24-hr cycle.
- It involves mental, physical and behavioural changes of the human body.
- The natural processes respond to light and dark.
- It helps to control the daily schedule of sleep and waking up.
- The processes follows sinusoidal changes.
- Day time shift helps to maintain the rhythm.
- Night shift affects the rhythm significantly.

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We are talking about circadian rhythm. When there is a change over from the biological system of morning shift to evening shift to night shift, there will be a change over a period of about 3 weeks. Sometimes if they extend their work period you can say overtime. these are some of the effects which will come into play; and therefore, this will affect the mental makeup of the person.

We know that the human body allows a system of 24-hour cycle and daytime shift helps to maintain rhythm, where night shifts affect the rhythm significantly well. We would like to discuss further design and see what is the best output from a shift work.

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I have given certain examples. (Refer Time: 02:13) For example, when a construction work is going on, you can see the different types of tasks a person is trying to-either shift load from one location or carrying a load from one location to another location. You can also think of the agricultural field operation.

For agricultural field operation see the portion at which this transplanting of paddy is going on. This is a posture which is maintained for several hours and these ladies have been involved perennially in this task. Now, you can assume if these people are there for 6 to 8 hours what will be the condition of their health.

Similarly, I will take an example automobile industry. You can see the different types of gadgets and different types of equipment and components which are there. He has to either assemble or look at the data and then manipulate some of the values, some of the information and then see that whether he completes the task which is in hand at that location.

In an automobile industry where either the components are added together or assembly is going on or checking is going on or rechecking is going on- whatever there could be various things. You can see the nature of job which is going on in the pharmaceutical industry. You can see the apron that they are wearing you can see the postures in the figure and the location of the particular job or the task place. In the pharmaceutical industry you can see what is happening in the whole circle of either production of those

bottles or bottling. Similarly, you see the work in underground mines, see the condition of the underground worker and you see the psychological effect of the person when he is there in the underground.

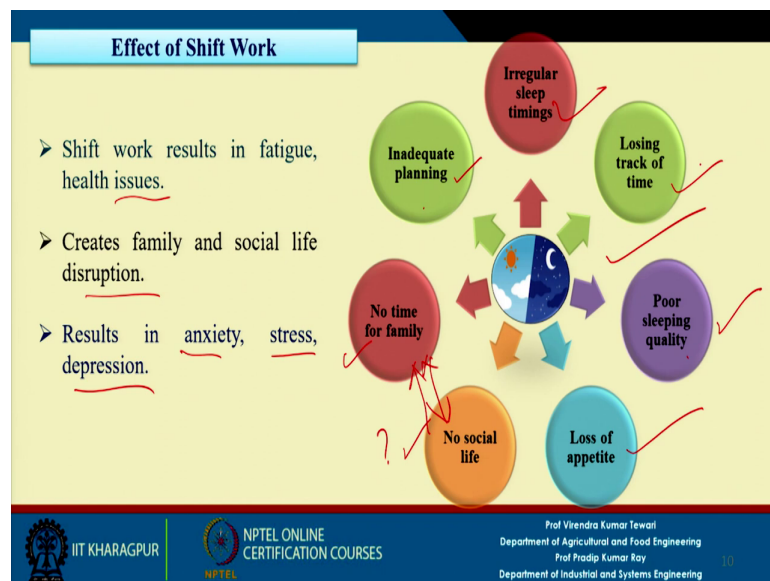
He knows that he is at least 5 kilometers below the underground and there are some lighting and few of the workers. Either he is being lifted, he has got down through a ladder or he has been through elevator and after that he has to walk for about a few kilometers to his work site.

When you come to the hospitals, when you are talking of a delivery or you are talking of the operation theatre, you see the conditions here the operands are there; these are 4 to 5 hours sometimes and these operations go on for long duration. So, when you are talking of day shift, when you are talking of both day and night shift and night work which are there, this gives you a better understanding of why we are taking into consideration the shift work which has to be given enough importance.

As far as the total work output of the system is concerned we needed to have a look at it. Because after all human being is involved in the system, he has to see, he has to keep his mind alert.

But still, he has to do the job and see things what is happening inside. Although this is a day shift, he has to do the job. This is another posture. They have to maintain the posture.

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What is the effect of the shift work? When you are having the effect there could be various things. Shift work results in fatigue health issues; it creates family and social disruption, results in anxiety, stress and depression. These are some of the things which has been put together, you see here poor sleep quality.

Depending upon which portion he or she is involved, there is every chance that the nature of sleep will get affected. Loss of appetite, it may happen that when you are talking of either; when you are going from 10 to 6 or when you are going from 2 to 10 you see what you are doing. During this period, you need to maintain your food habits or the food that you take, because you need to remain alert during the period.

Then of course, social life is questionable because sometimes, not all the shifts, in some of the shifts you do get time to have social life. When you are talking of those who are always in the night shift and late afternoon shifts, there is no time for the family. Inadequate planning depends on the task which the person is doing, whether proper planning is there or not.

When he is shifting or goes to a different shift, he also plans in his mind as to what will be the task that I am supposed to do. May be that he is doing the same task, but many a times this task may be also varied because that has an effect on the actual performance of the person in a given shift.

Irregular sleep timings-poor quality of sleep(Refer Time: 08:24). Losing track of time.

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- Online delivery boys (food and parcels) work in shifts to avail the food and parcels at doorstep of the customers.
- Exposed to adverse weather conditions that affects their health condition.
- Experiences improper behaviour and attitudes from the customers due to
  - Delay in delivery time ✓
  - Damage to the packaging ✓
- This affects them psychologically.
- Delay in time sometimes lead to loss of their pay.

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We have seen many types of jobs, I have just listed a few of them. This has become because of the different types of services available delivery of items at the house. There is a task that these persons do and try to deliver at door steps of these of the customers. They go through adverse conditions also does affect health because they need to perform the job well on time and therefore, it is possible that they are exposed to rough weather condition or sometimes unwanted weather conditions.

Many a times, for such strenuous jobs, although they are not very much mentally required, they do affect mentally a person because he has to maintain time. And maintaining of time keeping in view your health in perfect shape is a tough task. Therefore, it is very essential when we are talking of shift, we do need to talk about these jobs as well which are sometimes not necessarily in a given shift. But they could be 24-hour job, because some people may love to work.

So, they will carry things from one location to another location and various places and it does affect his health.

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We have picked up certain other aspects of the work. For example, adaption of awkward postures through the shift creates muscular skeletal disorders.

Now, in all those conditions, you see what happens is the posture, because while we are thinking of the mental health of the person, physical health of the person, we need to also discuss about how badly he is affected because of the nature of the job, nature of the posture that he assumes on the task.

For example, we have given example of jute industries where the person are involved in various kinds of the work which are there in construction industry. You must have seen lot of infrastructure development is going on across the country. You see the high-rise buildings and the amount of risk which is involved in doing the task- the bridge construction, the road constructions, the building construction and taller building constructions and so on and so forth.

In jute industries, the workers sometimes have to do; even this one shift, the amount of dust and noise which is exposed to them its tremendous. Therefore, we need to have a look at the nature of the job, the posture of the job, and what best can be designed in on the task itself so that they do not unduly get affected because of the posture- either they get hurt in their back or strain in their leg or their vertebra. You see here the food industries, we are talking the nature of task. Here, he is trying to put the material at some location, see the mining industry, see the people who are doing in a seated posture.

Whether you are talking of the total output, whether you are talking of the components output or components in the human beings, the environment which has been created with human and machine and the overall system.

You will understand that there is a need for work cycle design. We have seen the drivers working for hours together. They are working at the mercy of the operator. The boss who is delivering he will not know the actual feeling of the driver.

We have seen accidents taking place because early morning hours they have been driving for days together.

While we are trying to motivate the worker, we must also think of his health as well. Even in the driving as well, the posture the person assumes for hours together can also affect his health. Many a times we have seen that we maintain at the seat and the posture that is maintained at the driving seat.

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**Environmental factors**

Mines: Vibration and dust

Jute industry: Dust and Noise

Cold storage: Low temperature

Manufacturing plants: High temperature

During shift work in different industries workers work in unsuitable environmental conditions for long hours.

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While we talked of the environmental factors, this dust and noise you can see. Although these people are wearing masks or trying to protect themselves, there is some sort of well-prepared mask or some sort of towel and they do the work.

But that is not enough because the whole environment is such that it affects them either through the noise or through the dust which is coming up, the intensity of the dust, the

type of the dust because it directly gets inhaled. Sometimes, people are working mostly on the low temperature conditions.

Body requires a certain thermal condition, it will not require a temperature which is zero or sub-zero or a temperature which is 50 or 55 degrees Celsius. There is a need to maintain a body temperature. When we are talking of continuously working in a very low temperature and continuously working in very high temperatures.

Here, say for example, in manufacturing you can see the ladle he is trying to see when the iron is being made and this is very hot. While it is very hot even from 10 to 12 feet about 2000 degrees Celsius when the iron is boiling, you get affected.

While we are talking of continuous low temperature, continuous high temperature, in both the extremes it is essential to understand and appreciate. During shift work, in different industries workers work in unsuitable environmental conditions for long hours.

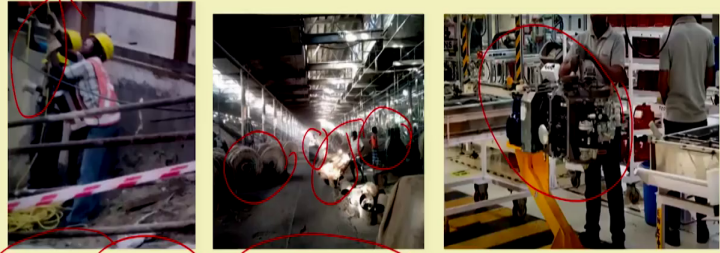
What is the nature of the work, what is the posture of the work, then we are talking about are the environmental factors which come into play? Shift work has to be taken in a different connotation. It is just not 6 to 2, 2 to 10, and 10 to 6. The different types of environments which are there, different types of conditions in which they work, different type of postures which they assume.

Their mental makeup and the shift at which those shifts are shifted from that the task which is given the circulation of these shifts on the workers, many things have to be seen in a broader context of things so that one can appreciate and make decisions for betterment of the system and to get most out of these.



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**Physical load**



Pulling of rope for material handling in construction work      Manual material handling in jute industry      Assembling task in tractor industry

High energy demanding task can not be maintained through out the shifts.

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We have talked of the physical load which is coming on to the person depending on the physiological condition of the person which we talked off. You see pulling of rope for material handling, construction work, some sort task which is being done. See the material handling which is taking place, these are some of the rolls which will be shifted, the physical loads which are being handled. While we are talking of the physical posture that we have, the environmental condition that we have, what is the nature of load. Sometimes we carry very high heavy loads from one location to another location and again there will be a posture which will come into play.


Assembling task in a tractor industry. Many a times the person has to stand, once the component comes here, he will have to knuckle down, or he had to tighten those things, fit those components, then the whole component will move away the part or the whole assembly will move away for other aspects of addition etc.

High energy demanding task cannot be maintained throughout the shift. When you want that high energy demanding task, you need to think about the shifts, you need to think about the welfare of the persons concerned in the shifts.

It is the shift which has to be understood in a broader aspect.

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**Work-Rest cycle**



**Transportation of mortar and brick**      **Brick laying**      **Truck driving at night time for transportation**

- Repetition of task and body movements for long hours create musculoskeletal disorders.
- Proper work-rest cycle schedule should be maintained during the shift work.

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Work-rest cycle. We just generally take a thumb rule- one third of the time is spent on a task the, one third of that is required for the rest which has to be distributed over a period of time in an 8-hour day.

Various other motivational tasks which are done. You see the brick laying task which is going on at this location here. Now, you see the posture here and then decide as to what should be the rest which has to be given. Truck driving at night for transportation, taxi drivers all these people when they go, many accidents do take place and if you have gone into details, you will find that the person is not alert. Therefore, it is essential that work rest cycles are designed and advocated, not only when we design.

Essentiality of helmet to be kept in mind. This has to be advocated and that is why many places people do carry helmets, but they do not wear them when they see a traffic police or somebody then try to wear.

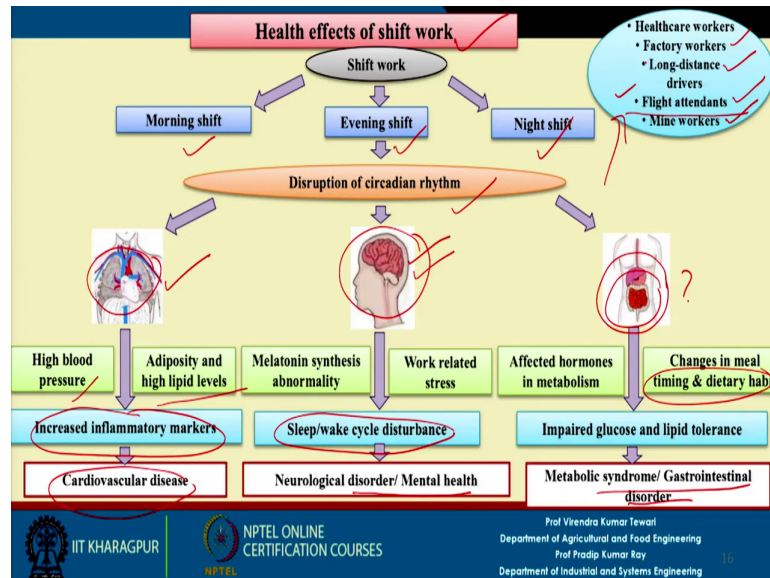
These are some of the tasks which people do and maintain.

Repetition of task and body movements for long hours create musculoskeletal disorders. The posture and the load, if you take them together, then yes it will happen, because if they are maintaining a particular posture with a certain physical load, it will definitely affect the health of the person.

Ultimately, Musculoskeletal disorder which will take up. So, proper work rest cycle schedule should be maintained during the shift work.

Many other connotations, many other aspects which need to be thought of.

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If you jot down everything together, you get health effects of shift work. The disruption of circadian cycle is certain, we are talking of the abnormality or work-related stress. There is weather abnormalities.

High blood pressure, then high lipid levels these are some of the things which may happen if it goes to the other side. Stomach dietary habits could change and then there will be stomach upset. This will come to sleep and wake cycle disturbances which will definitely happen.

Increased inflammatory markers or cardiovascular disease which people go through if this is coming through a high blood pressure; changes in the system which is happening because of the task. Then neurological disorder, mental health and metabolic gastro intestinal disorders; these are possibilities if you do not have enough food and proper digestion.

These are the health effects of the shift work which you are going to get.

When you are talking of the system, you will have to talk of the health of the machine, the maintenance of the environment and so on and so forth. While those are technical things we can maintain, but the human being is the one which is most important.

If he is not there in the system, it cannot work, somebody has to control the system. Flight attendants; they do have long distance while people take nap.

They do have less rest during the long hours of journey. It is important that we take care of all the stakeholders in a shift work design.

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The slide is titled "Selection of Individuals for Shift Work" in a pink box at the top. It contains two main sections: "1. Willingness:" and "2. Motivation". Under "1. Willingness:", there are two bullet points: "The individual should be interested to work in various shifts." and "Shift selection and job selection should be the individual's choice." Under "2. Motivation", there are three bullet points: "Motivation plays vital role to increase the efficiency and productivity of the individual.", "Individual should be motivated sufficiently to work the allotted job.", and "Newness in the job will create motivation by reducing the boredom they feel due to repetitions of the tasks by same individual." The slide also features logos for IIT Kharagpur, NPTEL Online Certification Courses, and the Department of Industrial and Systems Engineering at IIT Kharagpur.

Selection of individuals for shift work, this goes to fitting the task to the man. While we are talking of fitting the man to the task, we are talking of fitting the task to the man.

Many a times, there could not be a choice the person should be willing. He knows that there has to be a shift and he has to accept himself and mentally get prepared.

Individual should be interested to work in various shifts. Shift selection and job selection should be the individuals choice.

Now, have a dialogue. But many a times that is not possible because if there are 60 people to be put into and you take 60 opinions, it is not possible for the supervisor to allot the jobs. There has to be well preparedness or proactiveness of the worker.

Willingness and individual liking and shift selection should be given to his choice. He must own himself that he belongs to this organization and he has to do this job.

Sometimes, depending upon his requirements or sometimes may be the requirement of the family, the supervisor do come into play and they try to maintain a shift certain duration depending upon the requirement. Therefore, we will say that proactive point of view that willingness is important.

Then motivation, this is true when we are willing to willing to help the organization because ultimately, I am working for the organization I am being paid for the job which I am doing and therefore, I must be proactive in that. I should be motivated in a sense; not necessarily that only the motivation has to come from the management side. There has to be a level of motivation because I need to perform well in my task.

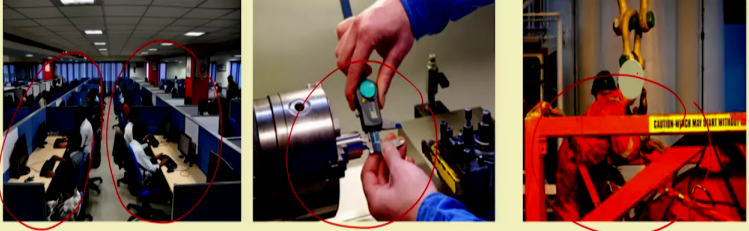
Therefore, motivation plays a vital role in increasing the efficiency and productivity of the individual. There could be a incentive by the organization.

Newness in job, this is another aspect. For a type of job, nature of job, if you bring certain newness in that, then there is a straightaway liking for that person. Because he has a feeling that I would like to contribute something into the system, he would like to do that.

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**3. Health condition**

- The individual should be physically, mentally and psychologically healthy for the shift work.



The slide features three images illustrating different work environments. The first image shows a call center with several operators at their desks. The second image shows a person's hands working with a mechanical component. The third image shows a person in a safety harness working on a structure, with a 'CAUTION' sign visible.

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Health condition; the individual should be physically, mentally, and psychologically healthy for the shift work.

Depending upon the nature of the task, and depending upon the quality of task to be done, and the sincerity, and the alertness which is required at each and every location and the people around.

The health condition of the person is very important. Because if he is healthy, he will have a good working life along with the other fellow colleagues who are working there. He will also try to have some sort of encouragement while working in the system as such, and psychologically also he will be alert and ready to take up the task.

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**4. Adjustment with the system**

- The individual should be comfortable in engagement to different shifts as per the need of the hour.

**5. Allotment of the job**

- Allotment to same kind of job for long time creates boredom for the individuals.
- Different kinds of job allotment to individuals will create interest in them.
- This will also add knowledge to the individuals.

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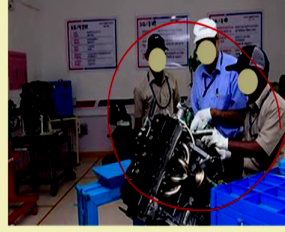
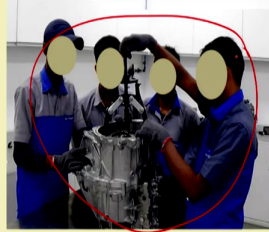
Adjustment with the system as well as the individual should be comfortable engagement to different shifts as per the need of the hour.

Allotment of the job; this allotment of different kinds of job adds knowledge to the individuals, increase interest in them and add knowledge.

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## 6. Training

- Training of individuals on various operations and tasks before engagement to various shift work will add efficiency and precision to the task.



Training; when you are talking of people, I think there has to be training has to be a part of it. It could be a new training; it could be new aspects of motivational training that you can give to them which will help the person to come to the new type of job or when he is introduced into the job.

The worker or the executive in the organization must have both way coordination for the betterment of the system.