Automation in Production Systems and Management
Prof. Pradip Kumar Ray
Vinod Gupta School of Management
Department of Industrial and Systems Engineering
Indian Institute of Technology, Kharagpur

Automated CAPP (Part-II)
Lecture - 60
Autonomation

During this session that the 5th session the 12th week. I will be discussing some other very important issues related to CAPP and one important issue is the Autonomation. And autonomation is a part of a particular approach or a particular method you use in Toyota production system.

And Toyota production systems is related to the production system based on the JIT principles. And many Japanese companies have adapted just in time principles.

There is JIT based manufacturing system implemented with respect to the process planning, you are preferring automated computer aided process planning.

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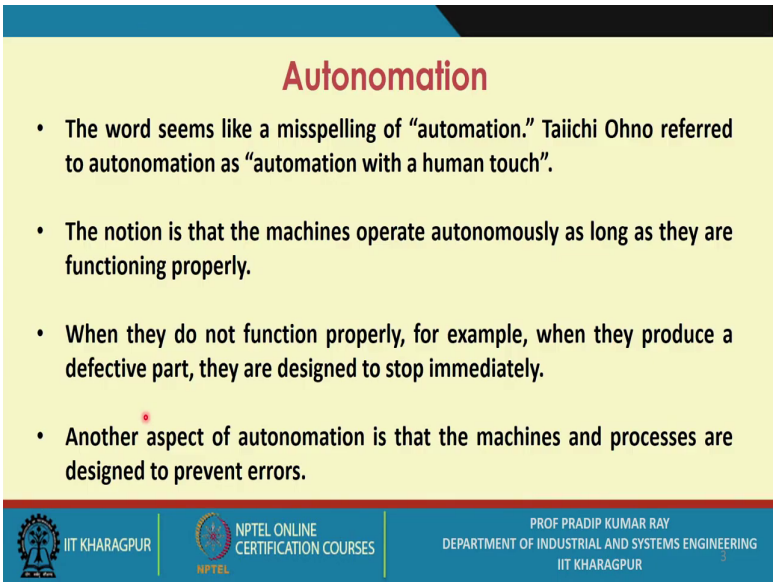

The word seems like a misspelling of "automation." Taiichi Ohno referred to autonomation as "automation with a human touch". The notion is that the machines operate autonomously as

long as they are functioning properly. When they do not function properly, for example, when they produce a defective part, they are designed to stop immediately. Another aspect of autonomation is that the machines and processes are designed to prevent errors.

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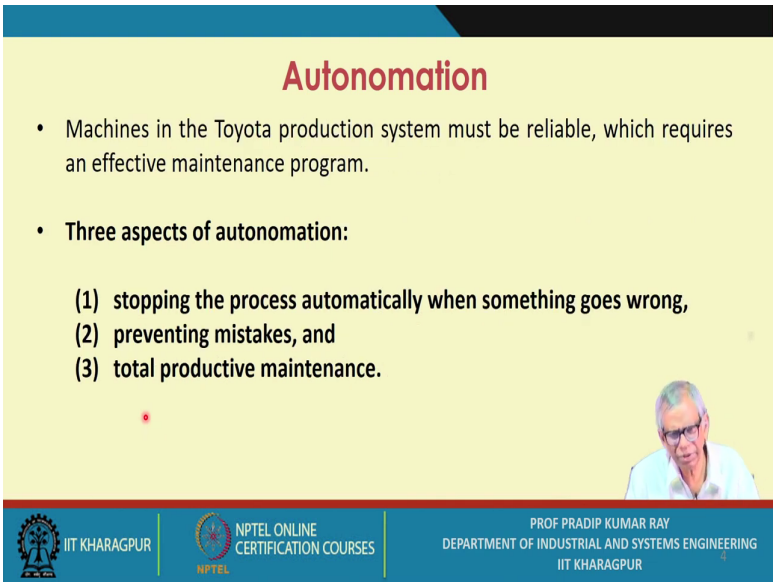

Errors can be of the different types. You must be able to prevent the occurrence of errors of different types, machines in the Toyota production system or TPS must be reliable, if not 100% reliable at least 99% reliable.

So, when you have a numerical measure, your reliability is 1, but there is early any chance or no possibility that the reliability will be exactly 1, it should be 0.99 or 0.999, but it just cannot be 1, which requires an effective maintenance program as soon as you stop functioning.

That means it is designed in such a way that comfortably you can do the maintenance jobs. That means, the system is such that very quickly you will come to know the kinds of falls and then quickly you need to know the different types of falls and the next the corrective measures or the trouble shooting measures and you take a minimum time to maintain the system.

We assume that it is a repairable system. So, quickly you have to do the repair, that kinds of systems are considered when you make the product or make the process considering the principles of the design for assembly or design for the maintainability.

This section covers these three aspects of autonomation:

(1) stopping the process automatically when something goes wrong,

(2) preventing mistakes, and

(3) total productive maintenance.

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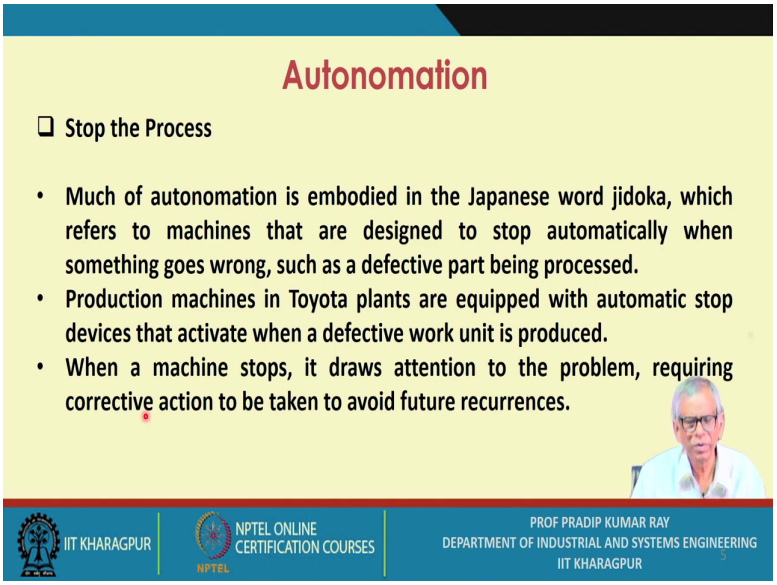

Much of autonomation is embodied in the Japanese word jidoka, which refers to machines that are designed to stop automatically when something goes wrong, such as a defective part being processed. Production machines in Toyota plants are equipped with automatic stop devices that activate when a defective work unit is produced. Therefore, when a machine stops, it draws attention to the problem, requiring corrective action to be taken to avoid future recurrences.

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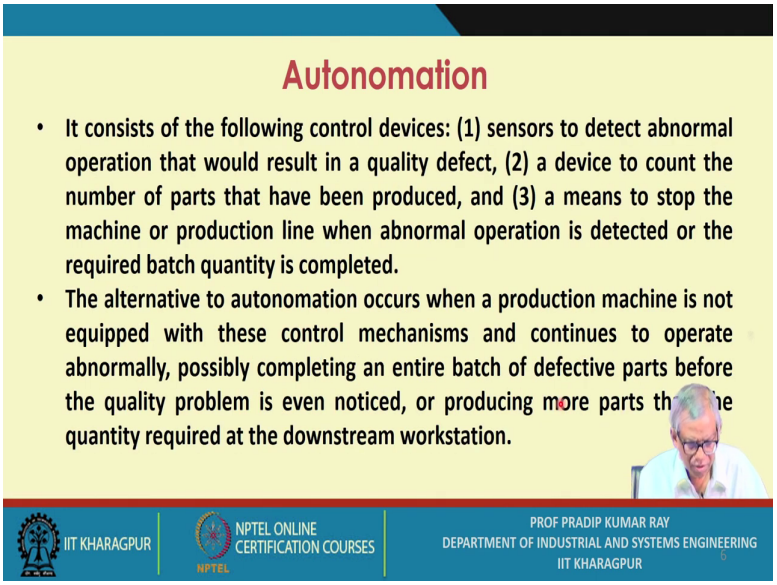

what are the control devices in typical autonomation? one is the sensors to detect automated operation that would result in a quality defect. Second one is a device to count the number of parts that have been produced and the third one is a method or the means to stop the machine or the production line.

The alternative to autonomation occurs when a production machine is not equipped with these control mechanisms and continues to operate abnormally, possibly completing an entire batch of defective parts before the quality problem is even noticed, or producing more parts than the quantity required at the downstream workstation.

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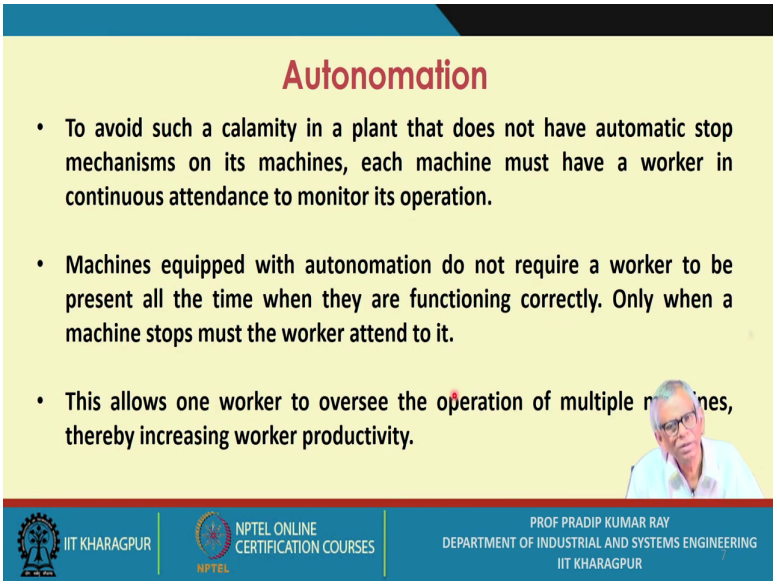

To avoid such a calamity in a plant that does not have automatic stop mechanisms on its machines, each machine must have a worker in continuous attendance to monitor its operation. Machines equipped with autonomation do not require a worker to be present all the time when they are functioning correctly. Only when a machine stop must the worker attend to it. This allows one worker to oversee the operation of multiple machines, thereby increasing worker productivity.

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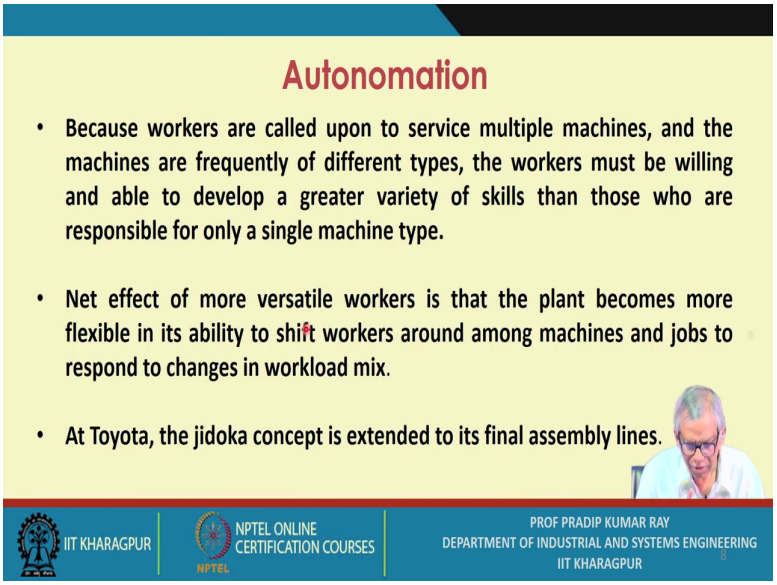

Because workers are called upon to service multiple machines, and the workers must be willing and able to develop a greater variety of skills than those who are responsible for only a single machine type. The net effect of more versatile workers is that the plant becomes more flexible in its ability to shift workers around among machines and jobs to respond to changes in workload mix. At Toyota, the jidoka concept is extended to its final assembly lines.

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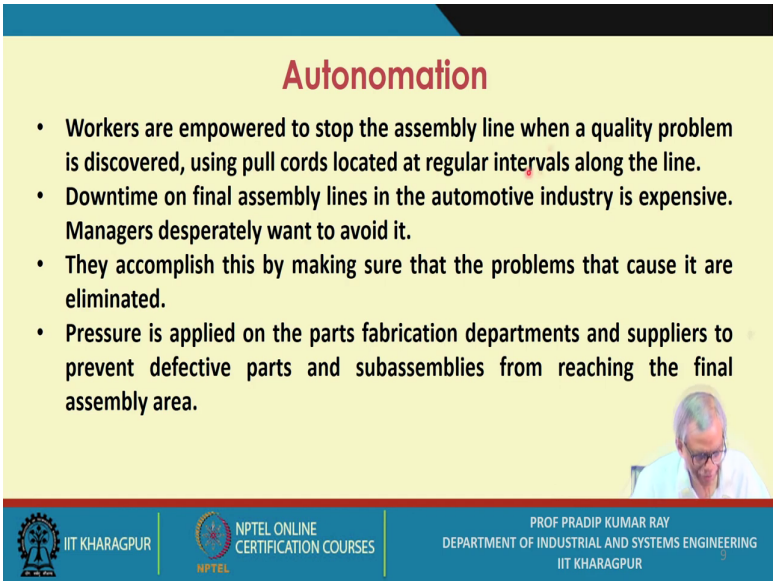

That means at the final the products stage, workers are empowered to stop the assembly line when a quality problem is discovered using pull cords located at regular intervals along the line. Downtime on final assembly lines in the automotive industry is expensive. Managers desperately want to avoid it. They accomplish this by making sure that the problems that cause it are eliminated. Pressure is applied on the parts fabrication departments and suppliers to prevent defective parts and subassemblies from reaching the final assembly area.

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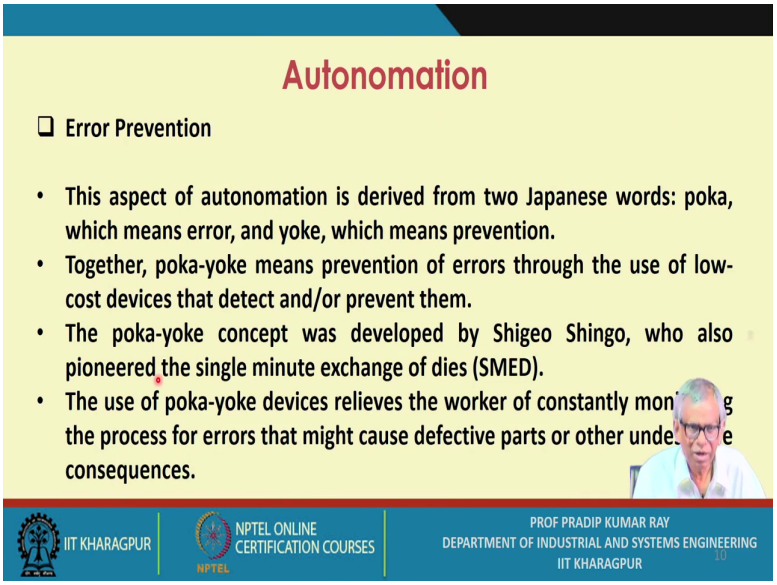

Error Prevention: This aspect of autonomation is derived from two Japanese words: poka, which means error, and yoke, which means prevention. Together, poka-yoke means prevention of errors through the use of low-cost devices that detect and/or prevent them. The poka-yoke concept was developed by Shigeo Shingo, who also pioneered the single minute exchange of dies (SMED). The use of poka-yoke devices relieves the worker of constantly monitoring the process for errors that might cause defective parts or other undesirable consequences.

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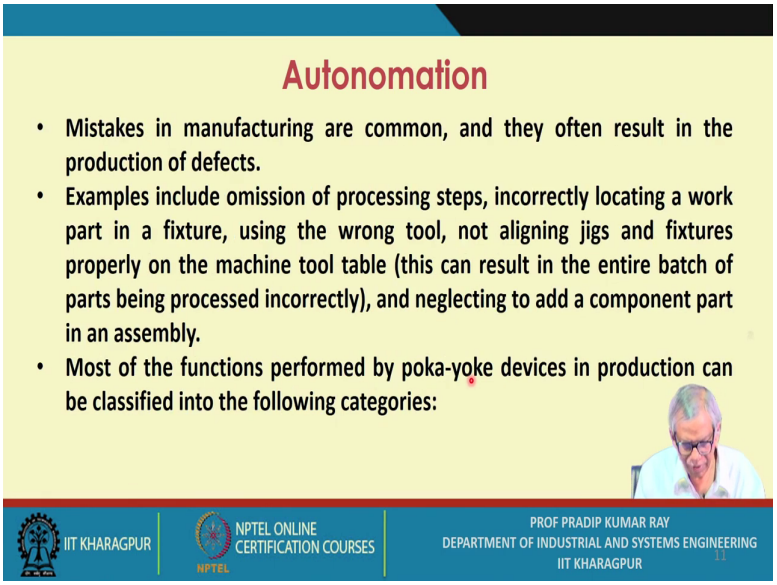

So, the mistakes in manufacturing are commonand they often result in the production of defects. Examples include omission of processing steps, incorrectly locating a work part in a fixture, using the wrong tool, not aligning jigs and fixtures properly on the machine tool table (this can result in the entire batch of parts being processed incorrectly), and neglecting to add a component part in an assembly. Most of the functions performed by poka-yoke devices in production can be classified into the following categories:

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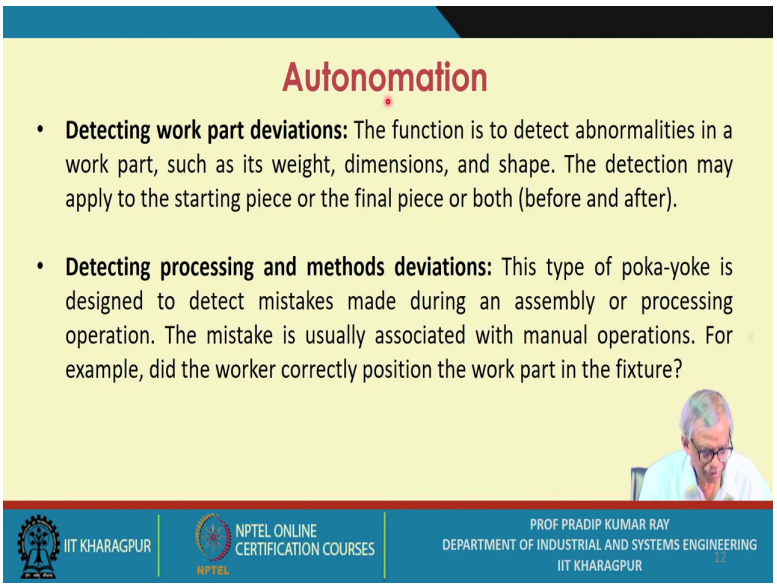

First one is the detecting the work part deviations. The function is to detect abnormalities in a work part, such as its weight, dimensions, and shape. The detection may apply to the starting piece or the final piece or both (before and after).

Second one is Detecting processing and methods deviations: This type of poka-yoke is designed to detect mistakes made during an assembly or processing operation. The mistake is usually associated with manual operations. For example, did the worker correctly position the work part in the fixture?

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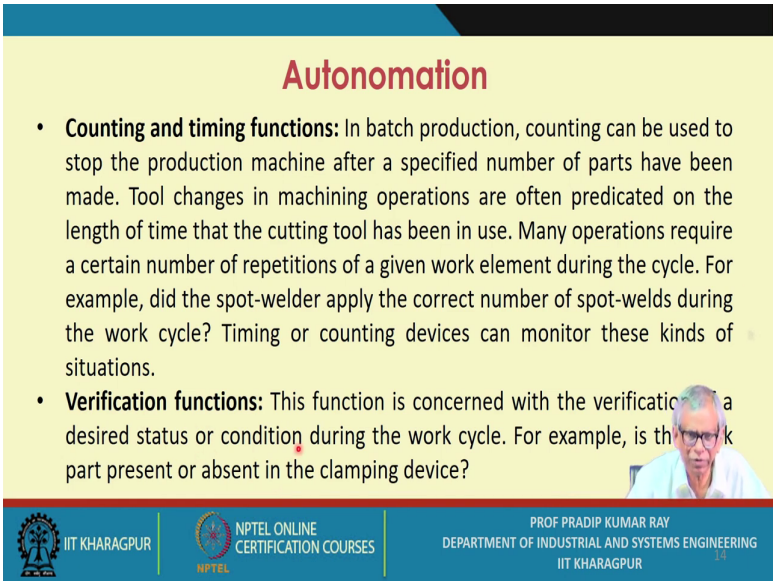

That is very important task that you have counting and timing functions, In batch production, counting can be used to stop the production machine after a specified number of parts have been made. Tool changes in machining operations are often predicated on the length of time that the cutting tool has been in use. Many operations require a certain number of repetitions of a given work element during the cycle. For example, did the spot-welder apply the correct number of spot-welds during the work cycle? Timing or counting devices can monitor these kinds of situations.

Verification functions: This function is concerned with the verification of a desired status or condition during the work cycle. For example, is the work part present or absent in the clamping device?

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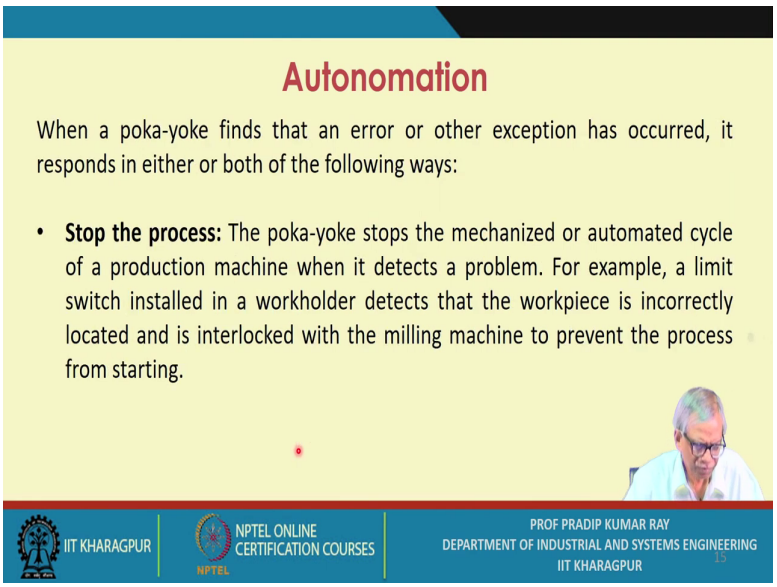

When a poka-yoke finds that an error or other exception has occurred, it responds in either or both of the following ways:

Stop the process: The poka-yoke stops the mechanized or automated cycle of a production machine when it detects a problem. For example, a limit switch installed in a work holder detects that the workpiece is incorrectly located and is interlocked with the milling machine to prevent the process from starting.

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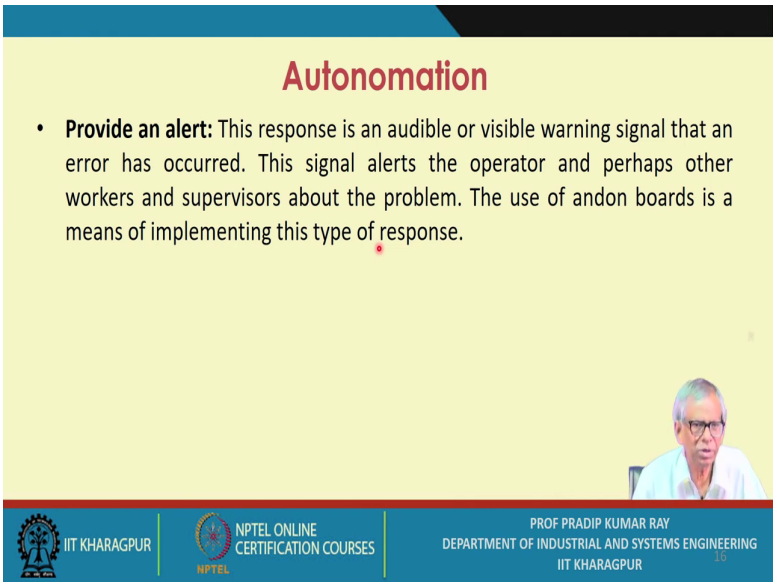

Provide an alert: This response is an audible or visible warning signal that an error has occurred. This signal alerts the operator and perhaps other workers and supervisors about the problem. The use of and on boards is a means of implementing this type of response.

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