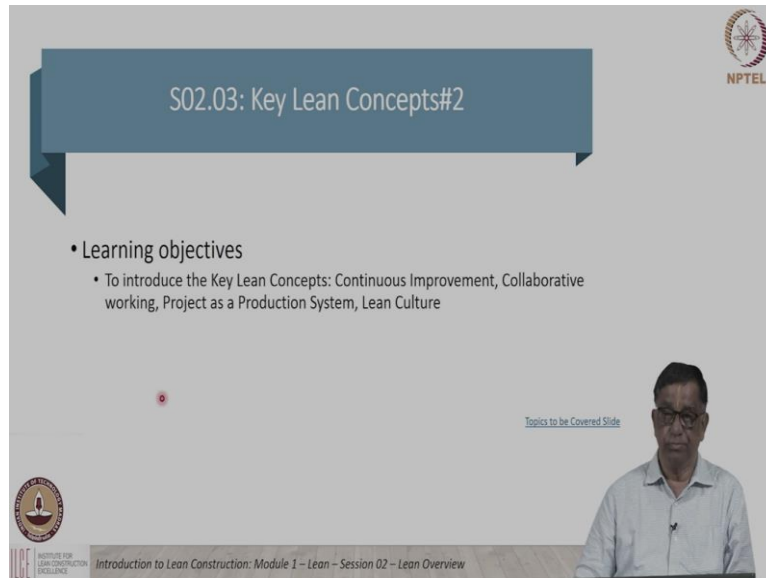


Introduction to Lean Construction
Professor N. Raghavan
Department of Civil Engineering
Indian Institute of Technology, Madras
Module 1, Lecture 10
Key Lean Concepts#2

(Continuous Improvement, Collaborative working, Production System, Lean Culture)

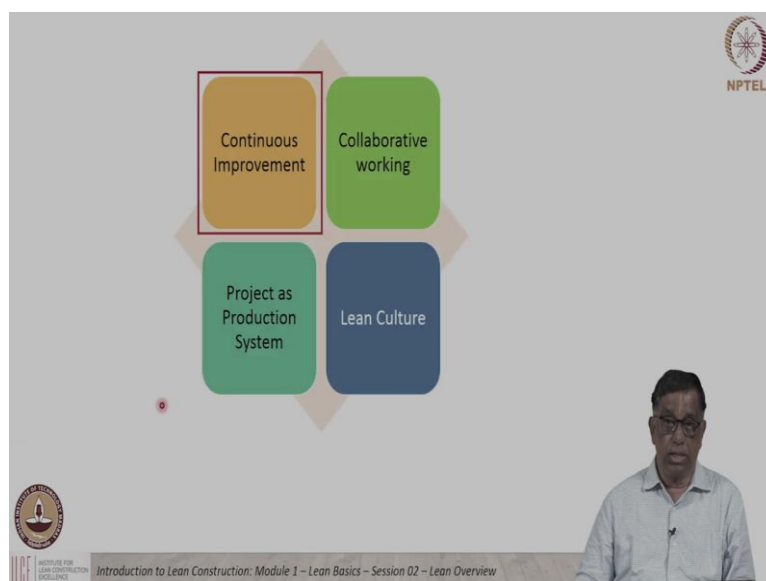
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The slide features a blue banner at the top with the text "S02.03: Key Lean Concepts#2". Below the banner, under the heading "Learning objectives", there is a bulleted list: "To introduce the Key Lean Concepts: Continuous Improvement, Collaborative working, Project as a Production System, Lean Culture". A small red dot is positioned on the slide. In the bottom right corner, there is a video feed of Professor N. Raghavan. The slide also includes the NPTEL logo in the top right, the IIT Madras logo in the bottom left, and the text "Introduction to Lean Construction: Module 1 – Lean – Session 02 – Lean Overview" at the bottom.


Now, we look at section S02.03, where we look at the lean concept, like continuous improvement, collaborative working, project as a production system and Lean culture.

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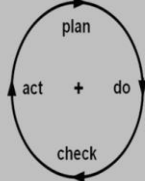


The diagram consists of four colored boxes arranged in a 2x2 grid, all enclosed within a larger, light-colored diamond shape. The top-left box is orange and labeled "Continuous Improvement". The top-right box is green and labeled "Collaborative working". The bottom-left box is teal and labeled "Project as Production System". The bottom-right box is dark blue and labeled "Lean Culture". A small red dot is located on the slide. In the bottom right corner, there is a video feed of Professor N. Raghavan. The slide also includes the NPTEL logo in the top right, the IIT Madras logo in the bottom left, and the text "Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview" at the bottom.


Continuous Improvement



- A Lean approach with Continuous Improvement provides a framework to *continuously examine work processes and seek better performances*. Various tools are available, and the cross-functional teams often bring new perspectives to the table.
- Lean thinking can provide *continuously improving Value for the customer* by:
 - Improving the *quality* of work processes
 - Reducing *errors or defects* in work processes
 - Reducing *waste and costs*
 - Improving *flow* of the process
 - *Simplifying complex processes*
 - Reducing *lead time*
 - Improving *employee morale*




Michigan Tech – What is Lean?



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So, to look at continuous improvement as the the first concept, very important concept. So, Lean is all about continuous improvement in every way that actually provides a framework to look at the work processes and seek better performance, all the time. It is not, you know, one-time activity. It is actually permeating across the entire process, from start to end. We keep improving continuously. So, there are a number of tools available with cross-functional teams, as usual. It is always better.

Some of the features, which are coming as a result of continuous improvement. We have improved quality of work processes. Then we can reduce the errors and defects, reduce rework. Then reduce waste and costs and increase the value to the client. Then the entire flow of the process can be improved, again, by looking at the continuous improvement. Then the complex processes have to be simplified by looking at them deeply. Then the lead times for the various, you know, processes can be reduced. And finally, employee morale can be improved by continuous improvement.

Everybody likes to work in an environment, which is continuously improving, where you have a positive kind of atmosphere, which is very very encouraging for employee morale. So, the ‘PDCA approach’ we talked about earlier. Plan Do Check and Act, that is very useful for continuous improvement.

(Refer Slide Time: 02:17)

The slide is titled "Continuous Improvement – Some Possibilities" and features the NPTEL logo in the top right corner. It contains a list of six bullet points:

- *CPS Process*: The constant quest for PPC to approach 100, the Root Cause Analysis approach to seek avenues for improvement and the feedback loops in daily, weekly and look-ahead planning
- *First Run Studies and the Plan-Do-Check-Act approach* for further improvement
- *VSM and WS studies* to examine current processes and seek betterment of overall productivity
- *5S* to make the Site an example of perfect Visual management
- *BIM usage possibilities* to do walk-throughs, check for clashes a priori, make betterment modifications with least efforts concomitantly checking for corresponding cost, etc.
- *Big Room approach* to get all stakeholders to brainstorm together to seek perfection.....

Below the list, there is a small text "Michigan Tech – What is Lean?" and a video inset showing a man in a white shirt speaking. In the bottom left corner, there is a logo for the Institute for Lean Construction Excellence (ILCE) and the text "Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview".

If you look at the various Lean processes and see where all we can apply continuous improvement, the first thing which comes to our mind is the CPS process. To use the concept called PPC there and the PPC the limit is only 100 percent. So, how do we get to, how do we keep improving PPC to come as near as close to 100, that is very important.

We do that by looking at the problems which have gone wrong, which are the problem, which are affecting us, which are preventing us from scoring 100 percent PPC. And for that we look at the root causes and eliminating the root causes. And we should remember that there are feedback loops in the daily planning to weekly planning, weekly planning to look-ahead planning and so on.

So, with all this, we have an atmosphere of continuous improvement. And we have these First Run Studies or mock-up work with the Plan Do Check Act approach again, an example of continuous improvement. We do various kinds of Value Stream Mapping, Work Sampling studies and so on. Again, all leading to improvement all the time.

5S is an example of perfect visual management, in our quest for continuous improvement. BIM, Building Information Modeling that gives you the framework or the platform, on which we can practice continuous improvement. Any change you make, you get the effect, the implications of cost and time immediately.

So, that helps you to keep on improving continuously and reduce the wastage, increase the value and so on. And the Big Room Approach again, is another example, where multiple

stakeholders come together and try to create value, try to create commonality, try to get to convergence and all the time improving continuously with multiple inputs. So, that was continuous improvement.

(Refer Slide Time: 04:16)

The slide features a central diagram with four rounded rectangular boxes arranged in a 2x2 grid, connected by a light-colored diamond shape. The top-left box is orange and labeled 'Continuous Improvement'. The top-right box is green and labeled 'Collaborative working'. The bottom-left box is teal and labeled 'Project as Production System'. The bottom-right box is blue and labeled 'Lean Culture'. The NPTEL logo is in the top right corner. In the bottom left corner, there is a circular logo for the Institute for Lean Construction (ILCC) and the text 'Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview'. A small red dot is visible on the slide.

Collaborative working

- “Collaborate” – “the *action of working with someone else* to produce or create something.”
- Collaboration starts with *sharing information and knowledge* across the team to *work together* to develop the *best project plan* within the applicable budget, schedule and quality constraints
- *True collaboration* requires the *face to face, hand to hand* working together in a collaborative space that makes all ideas visible, *allows all voices to be heard* and develops *several options to problem solving* that allow for choices among competing ideas for all aspects of the project
- Collaboration inevitably leads to *innovation*. It also has another; equally important benefit allows *trust* to develop

Dick Bayer (2020) - Culture Matters in Design and Construction (Lean Construction Blog)

The slide features the NPTEL logo in the top right corner. In the bottom left corner, there is a circular logo for the Institute for Lean Construction (ILCC) and the text 'Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview'. A small red dot is visible on the slide.

And, looking at collaborative working that is a very basis for the CPS or Last Planner System. Collaborative working, it is actually the action of working with someone else, to produce and create something. That is the basis of collaboration. So, we need to have, it starts with sharing information and knowledge across a team and to work together to develop the best possible project plan within the applicable budget, the schedule and quality requirements. That is where the collaboration part concern.

True collaboration normally is facilitated, if you have face to face, hand to hand working together of multiple people in a collaborative space that makes all the ideas feasible, visible and acceptable, and allows all the, you know, voices to be heard, to come to a common problem-solving mode, after having considered all the various viewpoints and converging towards the best.

So, this particular system, the approach, facilitates, you know, continuous improvement and collaborative working. That definitely leads on to innovation. Because, you know, you have multiple people working together and bringing synergy to make it, make the situation better all the time. So, innovation is very good.

And, finally with so many people working together and after having been heard, depending on others like that, you know, that sort of thing, also develops the trust part of Lean culture. So, trust again develops and innovation develops, after having practiced collaborative working.

(Refer Slide Time: 06:05)

The slide is titled "Cooperation vs Collaboration" and features the NPTEL logo in the top right corner. It contains two main bullet points:

- Cooperation**
 - An *interorganizational relationship* among participants of a project, who are *not* commonly related by vision or mission, in separate project organizations with independent structures, where the *project culture* is based on *control and coordination* to solve problems *independently* in order to maximize the value of the own organization.
- Collaboration**
 - "An *interorganizational relationship* with a *common vision* to create a common project organization with a commonly defined structure and a new and jointly developed project culture, based on *trust and transparency*;
 - With the goal to *jointly maximize the value for the customer* by solving problems mutually through interactive processes, which are *planned together*, and by *sharing responsibilities, risks, and rewards* among the key participants."

At the bottom of the slide, there is a small circular logo on the left and a video overlay of a man speaking on the right. The footer text reads: "Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview".

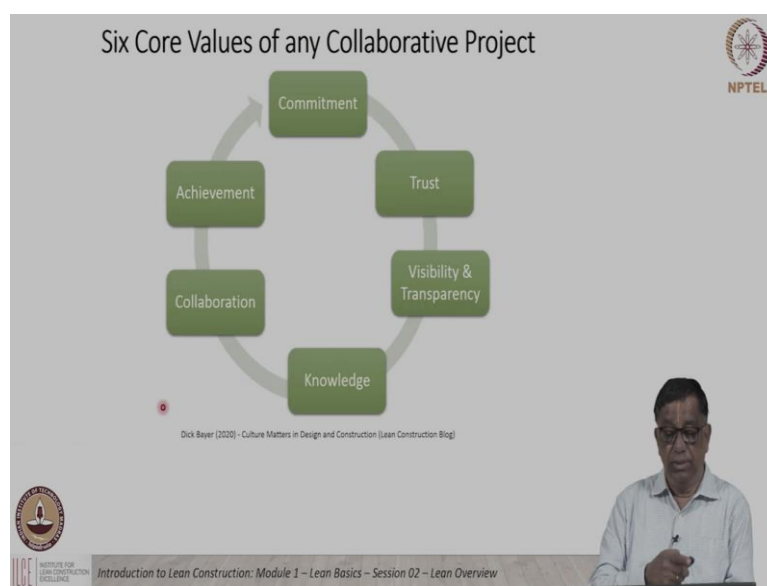
There is some confusion between cooperation and collaboration. We need to be very clear about that. Cooperation normally comes in, when you have different kind of organizations, with different culture, working together to achieve common objectives. And that can be done independently with proper coordination. But that is not true collaboration.

True collaboration happens when you have people within the same organization, coming to with a common vision to create the common organization, if they are not otherwise, and with

a lot of trust and transparency. Then they jointly maximize the value for the customer, by solving the problem through an interactive process, that is the collaborative process. They all plan together and they share the responsibilities, risks and rewards.

The collaboration is planned based on sharing the responsibilities, risks and rewards, that is very important part. So, we do not just collaborate and leave it like that. We also make sure that we come to the end part of it, that means your results are achieved together by proper collaboration.

(Refer Slide Time: 07:18)



If you look at the sequence of, you know, the process, we start with the commitment, that all people work together trust develops. You know, trust is the very key part in the collaborative process. And there is total visibility and transparency of all knowledge, which all the people possess. All the knowledge is put on the table, the total transparency and visibility.

Then they collaborate together, based on the trust, the knowledge and so on, then achieve the common objective, whatever needs to be achieved. So, the collaborative part that comes as a result of, starting with the commitment, to achieve the objectives in the process I have explained just now.

(Refer Slide Time: 08:03)

The slide features a central diagram with four rounded rectangular boxes arranged in a 2x2 grid, all enclosed within a larger, light-colored diamond shape. The top-left box is orange and labeled 'Continuous Improvement'. The top-right box is green and labeled 'Collaborative working'. The bottom-left box is green and labeled 'Project as Production System', which is highlighted with a red border. The bottom-right box is blue and labeled 'Lean Culture'. In the bottom right corner, a small inset shows a man in a white shirt speaking. The slide includes logos for NPTEL and IIT Bombay, and the text 'Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview'.

The slide is titled 'Project as a Production System' and features a table comparing three eras of project delivery. Below the table are two diagrams: 'PROJECT MANAGEMENT' and 'PRODUCTION MANAGEMENT'. A bulleted list on the right discusses key strategies of Ford's Mass Production and Frank Woollard's Flow Production, followed by the Toyota Production System (TPS). A small inset in the bottom right shows a man in a white shirt speaking. The slide includes logos for NPTEL and IIT Bombay, and the text 'Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview'.

ERA-1 PRODUCTIVITY 1900 - 1950	ERA-2 PREDICTABILITY 1950 -	ERA-3 PROFITABILITY 2000 -
SCIENTIFIC MANAGEMENT	PROJECT MANAGEMENT	PROJECT AS PRODUCTION SYSTEM
How to get more out of workers?	How to predict project outcomes through measurement and compliance?	How to deliver business objectives with minimal use of resources?

PROJECT MANAGEMENT
Cost, Time & WP + Scope & Quality + Process Design + Resource Use

PRODUCTION MANAGEMENT
Cost, Time & WP + Scope & Quality + Process Design + Capacity + Inventory + Variability

- Key strategies of Ford's system of Mass Production and Frank Woollard's Flow Production followed by TPS (Toyota Production System) include
 - maintaining a *flow of production* from the beginning to the end of the process or
 - the value stream by *reducing variability* and effectively *controlling the amount of work-in-process*.

The next concept we would like to look at is Project as a Production System. So, if you trace the development of projects right from the earlier times, we were looking at, from a basic point of view of productivity. Then we looked at predictability and today's environment, today's, you know, time period, we look at profitability, as one of the key components. That creates value and hence we look at profitability. So, the key strategies which Ford had of Mass Production, Frank Woollard's Flow Production and followed by the Toyota Production System, they all include a basic flow of production from the beginning till the end.

And then reducing variability by controlling the amount of work in progress. Work in process or work in progress. So, the main concept here is to reduce the variability. If you look at we say production, normally, we mean the production from a factory, where the same process

goes on, day after day, with the same set of people, with the same process, same starting point, same objectives. So, you have total controlling, total certainty, zero variability.

Whereas, construction every project is different, the stakeholders are different, the processes could be different, and then you know we have a lot of variability due to the environment also. So, how do we control all these variabilities? By adopting something like Last Planner System or the Collaborative Planning System. And then we bring in the look-ahead planning consistent with removal of constraints. Then we narrow down to the weekly plan, daily plan. We have the feedback loops. All the time we are trying to eliminate variability, improve the certainty level and reduce the work in progress.

So, earlier days, we used to say, cost and time and work in progress to go towards the, you know, with the goods and quality, the process design and the resource use. But, today we have, apart from these three, we also bring in the capacity, inventory and tackle the variability. So, once variability is tackled properly, we have a production system fully developed in place, that we need to remember.




(Refer Slide Time: 10:28)

The slide displays four interconnected concepts arranged in a 2x2 grid, each within a colored rounded rectangle. The top-left box is orange and labeled 'Continuous Improvement'. The top-right box is green and labeled 'Collaborative working'. The bottom-left box is teal and labeled 'Project as Production System'. The bottom-right box is dark blue and labeled 'Lean Culture', which is highlighted with a red border. The boxes are connected by a light-colored diamond shape. In the top right corner, there is the NPTEL logo. In the bottom left corner, there is the IIT Bombay logo and the text 'INSTITUTE FOR LEAN CONSTRUCTION ENGINEERING'. At the bottom center, the text reads 'Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview'. In the bottom right corner, there is a video feed of a man in a white shirt speaking.

Lean Culture

- “*Values, attitudes, beliefs, orientations* and underlying assumptions prevalent/ shared among” our team-mates - in short, “culture.”¹
- “Culture is defined as a *social domain* that emphasizes the practices, discourses, and material expressions, which, over time, express the continuities and discontinuities of *social meaning of a life held in common*.”¹
- Culture is the “stuff” we *believe* in so much that we teach it to those that follow us. It forms the common, *unspoken understanding* of how we work together²
- A shared Culture makes it easier for a process to be sustainable in the long run on “auto-pilot” mode- no one has to be told how to behave!
- The Toyota Way arose from the Toyota Culture - Inspired & Empowered people, good Communications, Continuous Improvement

Dick Bayer (2010) - Culture Matters in Design and Construction (Lean Construction Blog), Huntington (2009), Paul James et al (2015)

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The last concept we look at today is the Lean culture. And what is the culture? The culture actually is a set of values, attitudes, beliefs and orientations, which are shared together. So, they are prevalent in the organization, so that forms a culture. In the culture, everybody knows how to behave, they share common beliefs and values, they do not have to be told. That is actually culture.

So, if you have a social domain that emphasizes, you know, the various practices, discourses, or you know, the way people talk to each other, and the material expressions, which over time, it expresses the continuity, discontinuity, in the same meaning, and the same principles held in common by all the people that becomes culture.

So, culture actually, you know, you have a common set of beliefs, which are unspoken, understanding between the various people that again develops over a period of time. So, if you have a shared culture, all the people for sharing that particular culture, they are in something like an autopilot mode. They do not need to be told. They behave in the same particular manner.

So, the Toyota way, if you look at the Toyota culture, that was again inspired and empowered people, good communications and continuous improvement. So, these attributes were developed and shared between all the employees. So, they all tended to behave in the same way which was called the Toyota way or the Toyota culture.

(Refer Slide Time: 12:05)

The slide is titled "Lean Culture (cont.,)" and features the NPTEL logo in the top right corner. It contains five bullet points discussing the development of a team culture, the need for a common organizational culture, the importance of a project team culture, the role of aspirational sayings, and the attributes of Lean Culture. A video inset in the bottom right shows a man speaking. The slide footer includes the ILCE logo and the text "Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview".

Lean Culture (cont.,)

- Need to *develop a culture amongst the team* that is supportive of our value system and that encourages the kinds of behaviors, which contribute substantially to project success and are *Sustaining*
- Each of the participants may come from a *different organizational culture*. Still they need to develop in the new organization a common type of culture with the same behaviors, attitudes, values and rules supporting and encouraging good practice
- However, in the absence of that (realistically), the power to create and manage teams to develop a *project team culture* that allows a *fully collaborative delivery model* is necessary
- **The Right Culture:** The right project team culture requires more than just *aspirational sayings* to encourage a "*positive attitude*." It requires *space and tools and processes* that allow the Culture to develop and flourish
- Some Lean Culture attributes: Trustful, open-minded, Globalistic, Collaborative, Innovative,...

Dick Bayer (2020) - Culture Matters in Design and Construction (Lean Construction Blog)

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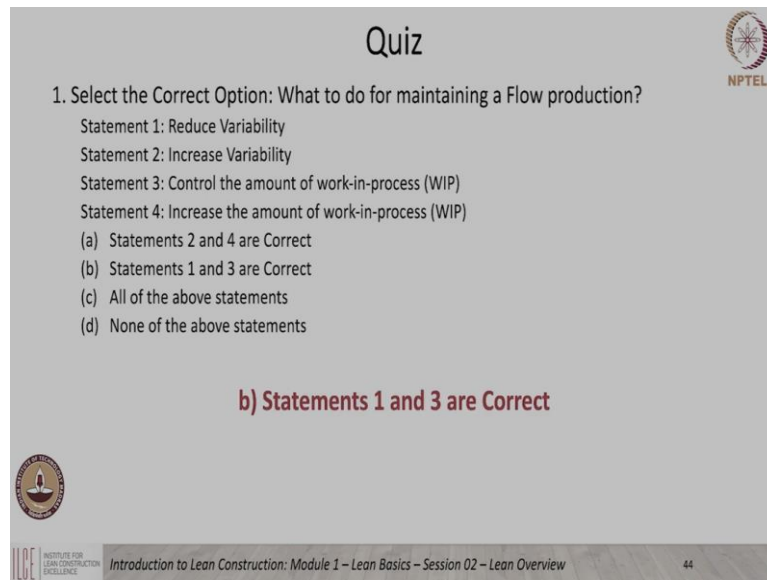
So, again we need to develop a culture amongst a team, if you wanted to be working together in the long run, in the same manner, in a sustainable manner which is sustaining in the long process. So, that is why the culture is very much required. Even if each participant comes from a different organizational culture, they need to develop the current organization's culture in such a way that they all are supporting to each other, to encourage each other and behave in the same way.

If you have a project team culture which is a common shared understanding, then you have a fully collaborative delivery model. Otherwise, that collaborativeness does not really take place between the various people. The common shared culture that is very important. So, the culture actually goes much more than only the aspirational sayings. We must do this, we will achieve that, it go, but it also encourages a positive attitude, that, you know, people have to behave in a particular way and the same space, tools and processes are very important to put together in a proper way to develop the culture.

For example, in the Lean culture, we have attributes like being trustful, open-minded, globalistic, collaborative or innovative. So, these attributes, they do not come, you know, just like that. They have to be developed. And that comes in a positive encouragement, getting all the people in this, in the organization to think alike, behave alike and work alike. That is where the parts and that is facilitated, if you have these attributes like being trustful, open-minded, being globalistic, etc.

So, basically if you get the right attributes, which are actually understood, which are implicitly followed by all the people, like I said, in an autopilot kind of mode, then the culture is totally prevalent and work can be done the way we need to do to get the common objective. So, the culture is a very very important part of the process, which to attain, for example, the Lean way or the Lean method of doing things for a particular project. Thank you.

(Refer Slide Time: 14:28)



The image shows a quiz slide from an NPTEL presentation. The slide has a grey background with white text. At the top center, the word "Quiz" is written in a large, bold, black font. In the top right corner, there is a circular logo with a star-like pattern and the text "NPTEL" below it. The main content of the slide is a quiz question: "1. Select the Correct Option: What to do for maintaining a Flow production?". Below the question are four statements: "Statement 1: Reduce Variability", "Statement 2: Increase Variability", "Statement 3: Control the amount of work-in-process (WIP)", and "Statement 4: Increase the amount of work-in-process (WIP)". There are four multiple-choice options: "(a) Statements 2 and 4 are Correct", "(b) Statements 1 and 3 are Correct", "(c) All of the above statements", and "(d) None of the above statements". The correct answer, "(b) Statements 1 and 3 are Correct", is highlighted in a bold, dark red font. In the bottom left corner, there is a circular logo with a lamp and the text "INSTITUTE FOR LEAN CONSTRUCTION EXCELLENCE". At the bottom of the slide, there is a footer with the text "Introduction to Lean Construction: Module 1 – Lean Basics – Session 02 – Lean Overview" and the number "44" on the right.

Quiz

1. Select the Correct Option: What to do for maintaining a Flow production?

Statement 1: Reduce Variability
Statement 2: Increase Variability
Statement 3: Control the amount of work-in-process (WIP)
Statement 4: Increase the amount of work-in-process (WIP)

(a) Statements 2 and 4 are Correct
(b) Statements 1 and 3 are Correct
(c) All of the above statements
(d) None of the above statements

b) Statements 1 and 3 are Correct

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