Introduction to Lean Construction
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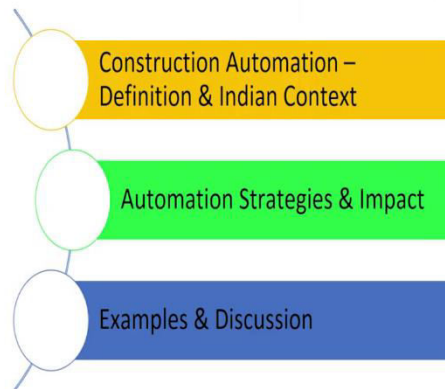**Future Construction Site, Lean Tools and Processes, Automation strategies & impact,**
Programming

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Good day everyone. Welcome to this session on automation and lean. So, this is a topic that is very broad, these are some of the aspects we will cover, we will talk about construction automation. We will define it in the Indian context because there is always a question as to is automation relevant in a country like India. We will discuss this a little bit. We will look at various automation strategies and their impact and then along with this discussion we will also give examples so the part two and part three here will be done all together. But these are the general topics which we will touch upon.
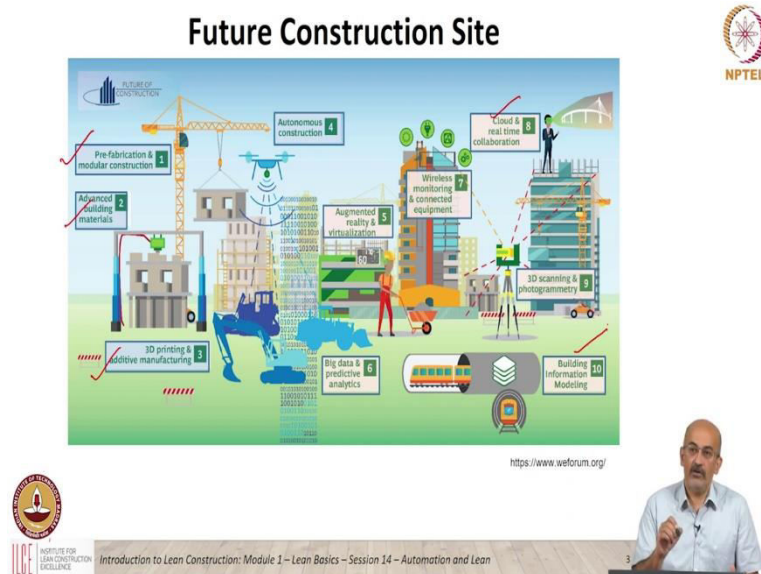
So, when we go into construction automation, so this is a slide that was been developed by the world economic forum and what they call it is the future construction site. Some of these technologies such as prefabrication or building materials or 3D printing are very physical oriented. They take care of the physical aspects of the project, others I can see real-time collaboration in cloud or BIM are more what we call digital or IT aspects.

So, when we talk about automation there are two dimensions, one is what we call the information or the digital technology, information technology dimension the other is the physical or we can call it the robotic more of where there is action, there is sensing, there is physics behind it. So, both these dimensions are important when we look at the whole gamut of automation.

And you can see some of the technologies that are anticipated, I think some of these technologies are already here. We will cover many of these in this session and see how does lean impact the technology or how does the technology impact lean. I will not go into this slide in detail because we will be touching on many of these as we go through.

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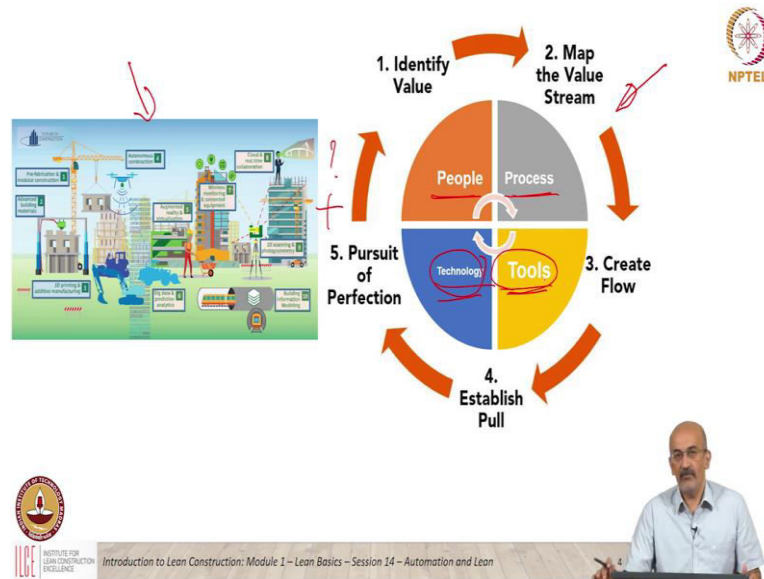
So, when we look at the concepts of lean as we have studied so far and we look at technology, where do these integrate? What happens? That is really the topic of this session. We are not going to look at each of these five principles in detail with respect to technology but we will talk about it in general.

So, when we for example look at implementing this we are also familiar with this framework where we talk about people, process, tools and technology and obviously the technology is central here. We are saying that in an implementation of lean tools and technologies are a part of how we bring about lean implementation and definitely it is really we know a lot about it is about people and process. But these are also enablers. So, we will look at how these technologies and more enable the lean process through this framework.

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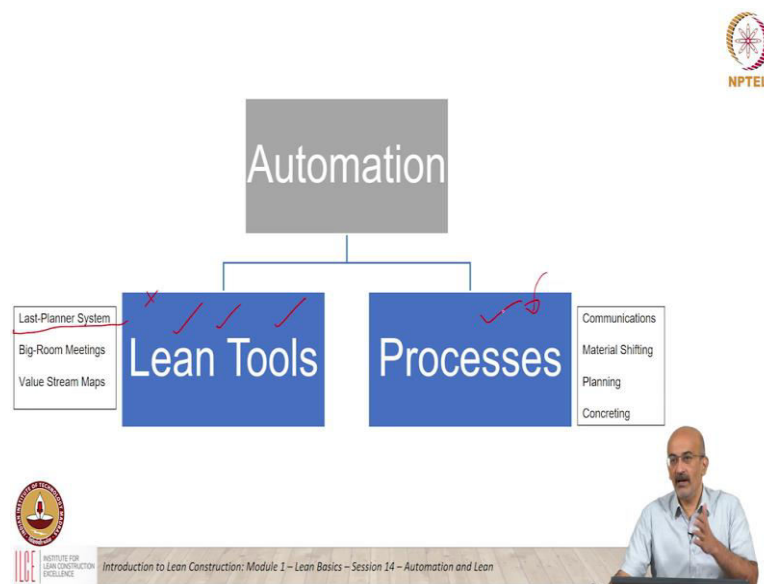
Now when we again look at it from an automation perspective, we have lean tools and we have processes. So, we are familiar with the tool say the last planner system, big room meetings, value stream maps, we are familiar with the tools. We have covered a lot of the tools. We also understand that lean is all about processes when we are looking at communication process, material shifting, planning, there are detailed processes there are macro processors, we talked about micro and macro.

So, when we look at automation the use of automation for lean tools is very very common. So, for example, you can go to the websites or go to the internet and see how can last planner system be enabled with software. Because, they have collaboration tools, they have other kinds of tools or big room meetings enabled through video conferencing systems, data gathering systems things like that.

So, all the lean tools which we have kind of covered in this course and beyond are enabled by various specialized software or even a regular standard software that are there to assist communication or assist documentation et cetera. So, this is, I mean, I think we all can readily see that. So, we will not discuss too much about this. We will more discuss at the process level, how do these technologies enable?

So, this is a given there are a lot of specialized software which you can go look each tool has. Today again with apps on cell phones there is just a lot which have been ported to cell phone based apps or smart phone based apps and the list is endless. This is where a part of the core lies, in how do these fundamentally affect. What we are doing in the process?

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Now coming to this context of automation in India or automation in an emerging nation. So, here is an example, if we look at a track, laying a rail track or even laying the sleepers on a rail track, we have three methods that are followed in our country. We have a highly automated system which is being followed in the freight corridor. We have kind of a mechanized system which is very common in many of our sites. We also have a very manual based system.

Now which should be used? What should we use?

Student: depends on size of the project

Professor: So, in many ways it depends on size of the project. Now, here there are a lot of safety issues as you can see definitely we should move away from risking the workers, risking so much of laborious work but in some cases this is still being done. But here is an example of, I would call appropriate automation. We have taken away the risks, we have brought in, which would be more productive.

There is there is a certain economy here, there is productivity and there is less risk to workers. But here there will be highly automated kind of railing, when the freight corridor is required we have time constraints, we have obviously getting the time the freight corridor ready on time is the most important factor. So, highly automated approach works.

Here it might require be less time intensive, might be a partially mechanized automated construction work. This might be there are projects which this is still used, but we should

certainly transition to this, at least. And in the long term, might be we will need this because our projects become so important.

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But ultimately when we look at an emerging nation like us, we will see that we will need all three types of construction approaches. We will need, in our rural projects et cetera we will need labour intensive construction. We will need mechanized construction on several projects where we need to get things on time but we do not have the capital expense, the budget to be able to bring in capital equipment which is very heavy.

We need automated construction where they are critical infrastructure projects time is really required and national infrastructure, we need automate automation. So, when you look at a country like us, we do need all, we need the whole bandwidth. So, assuming that automation is not relevant to India, is not really correct that is one and here we have looked more at physical automation.

And I think all of us are aware that information technology automation, we have been absorbing it and using it and benefiting it from it in a big way.

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Automation Strategies & Impact

No.	Automation Strategies	Manual effort reduction
1	Programming /Computation	Performing tedious and repetitive calculations
2	Data/Document Management/	One time creation with Remote shared access of data/documents
3	Workflow / Business Process/ERP	Seamless transfer of right information between processing units
4	Communication/Collaboration/ Authentication	Transparent, Reliable & effective participation from remote locations
5	Sensing / Tracking	Ubiquitous & continuous data collection
6	Mechanisation / Robotics	Less physical work
7	Visualization / Simulation/ Gaming	Experiential What-if Analysis
8	Artificial Intelligence / Analytics	Decision making - support
9	Building Information Models	Integrated platform of several technologies- focus on 1,2,3,4,7
10	Cyber-Physical Systems / IOT/ Industry 4.0	Integrated platform of several technologies: focus on 1,2,5,6,8
11.	Digital Twin	Integrated platform of several technologies- 9 & 10

Introduction to Lean Construction: Module 1 – Lean Basics – Session 14 – Automation and Lean

Now, this is a key slide. This kind of outlines, the kind of strategies and technologies which we will discuss in the rest of the session and there are, I have classified the automation strategies into these 11 categories. And as we go down, I think you will find, we will all recognize programming and computation is been there from the advent of computing, this is the most conventional and in some ways this is at least until five or six, there is a little bit of a timeline.

But then all of the new technologies are developing rapidly that there is probably no timeline as you get down the list. But definitely programming and computation I think, all of us are aware. We are aware of what data and document management is. We will go into this a little more detail, might be some of you are not aware of what a workflow or a business process ERP is, but I think this would be something we will touch upon.

We are all using communication collaboration and tools, authentication also. When we do a bank accounts or anything in some way or other we are using these tools. All of us have some sensors with us, our cell phones have so much of sensing in it, they are tracking us. So, this is an example of what we do, how does it apply to lean, how does it apply, making lean construction or enabling lean construction.
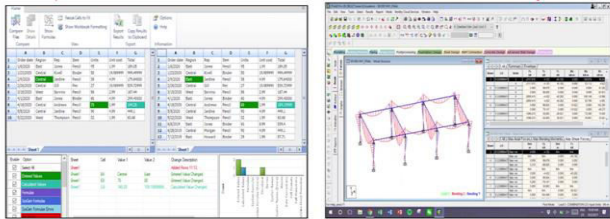
We are all familiar with mechanization and robotics in general and we will have to see where it kind of has an impact in construction and lean concepts. Visualization simulation gaming has become every day today. Whether, I mean, what used to be an advance requirement, advanced technology requirement today with your cell phone and something like a google cardboard you can do, immersive visualization.

AI and analytics again, very commonly used terms. We will cover this in a bit. BIM, become very common in the construction industry. I think my colleague Ashwin, is also giving more detailed lecture on this but we will cover this from an overview perspective. We look at industry 4.0 or internet of things, cyber physical systems very relevant to construction again and finally the digital twin concept which is emerging from all this.

We will take all of these 11 briefly and look at it how it applies in the lean context. We will only be giving an overview, I think each of these topics on its own can be researched and there is a lot of depth and lot of insights one can get into kind of analysing where it applies in the lean adoption. So, if you use the five principles of lean, how does this enable each of the five or how does it kind of reduce waste. So, there is a lot more discussion that can be done but I will basically touch upon the key points.
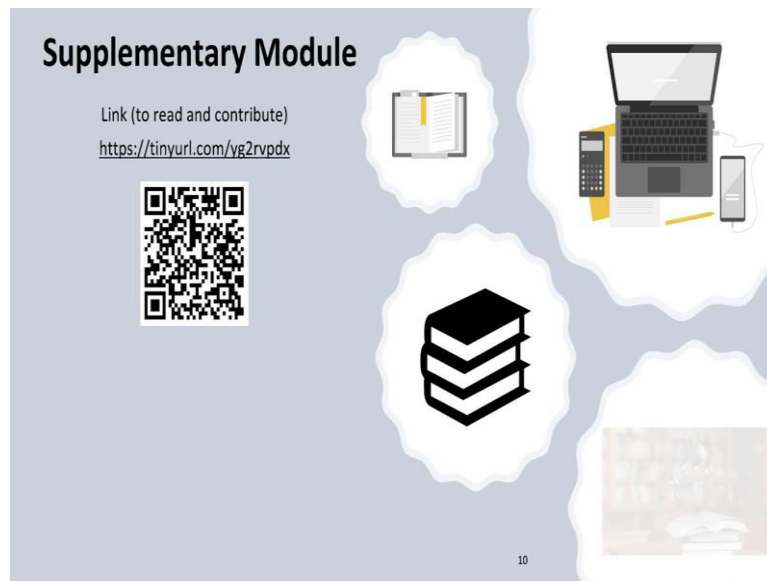
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Supplementary Module

Link (to read and contribute)

https://tinyurl.com/yg2rvpdx

When we talk about programming and computing, I am just using two simple examples which we are used to here, recognize these screens. What is the screen here? What software is it? Simple, everybody uses it, excel or a spreadsheet. So, it is a computing tool, it is basically what we use excel is for computation a lot. We make sure that is and any suggestion on what this is, e-tabs or staad is basically a structural analysis software.

Again, this is in civil engineering and our processes this has been one of the most earliest uses of computing. We did all of our analysis whether it is structural analysis or our hydraulic or whatever with computing, we took away the computing load. We took away the mundane load of computing and the designer could do these computational computers and focus on the design aspects.

Now let us think how does this affect training, when he said we are used to these. How does this affect a lean implementation? What happens when we implement this into a project? How does it enable lean? So, if we look at it that we said it performs tedious repetitive calculations error free. That is a service we get; we might be getting more about it but this is basically there.

And what happens to process time? Decreases, quality improves, rework decreases, variability decreases. We can explore more alternatives. So, we might get a better solution than what we decided if we were going to do it manually with one iteration or two iterations. So, you can see this, even when we take basic computing, it has a large impact on these dimensions. I am not translating this into specific more details but I think we get the idea as to where it enables lean.