

Introduction to Lean Construction
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Module 1
Lecture 28
Illustration of Tour-based work Sampling Approach

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Work Sampling Outcomes

- Awareness of the extent of NVA & NVAN -> WASTE
- Detects where attention needs to be focus
 - To identify waste
 - Discuss root causes

Coaching
Mitigation Plan → *Material*
Tools & Work

Percentage

Category	Percentage
Standing idle	~20%
Tying rebar	~10%
Sitting idle	~10%

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Tour-based Sampling – Illustration

Categories	Tasks
VA	Bending rebar, Tying rebar, Placing rebar, Fixing forms, Forming scaffolds, Fixing scaffolds
NVAN	Instructions, Curing, Holding ladder, Moving ladder, Holding measuring tape, Holding leveling staff, Holding & aligning rebar, Joining rebar, Cleaning aggregate chips, Cleaning shuttering forms
NVA	Waiting for material, Standing/ Idle, Using mobile, Sitting/ Idle, Talking, Walking, Chipping concrete, Folding safety belt, Break/ Idle

Multi-Storey Building: Bending, tying and placing Rebar; Fixing Forms; Forming and Fixing Scaffolds

Link to video: <https://youtu.be/EAGH2nKjFY>

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So here is an example. what you have taken is again a multi-storey building where there is, all of these activities are going on. Bending, tying, placing, formwork, you know, fixing

scaffolds and the team that did this chose to classify value added as these activities here. You can see bending rebar, tying rebar, placing rebar, fixing all of that non-value added but necessary as. The activities you can see here, instructions holding ladder, moving, all of these are necessary and non-value added as waiting, standing idle, using mobile, all of these are non-value added.



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Tour-based Sampling: Random Time



Date									
Tour #	Start Time	—		Stop Time				—	
Sample #	VA			NVAN			NVA		
	VA ₁	...	VA _n	NVAN ₁	...	NVAN _n	NVA ₁	...	NVA _n
1			1						
⋮									
n									
Total observations		a			b			c	
Individual Categories (%)		—			—			—	
Three Main Categories (%)		—			—			—	

Link to Spreadsheet (download to edit): <https://tinyurl.com/ygt8of8s>

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And we are now looking at the three methods if you remember, there is a random approach, there is a periodic approach and a continuous approach, this is the format they used. Again, this is only a suggestion format, now in this format, they basically took they have a start-time, end-time of when the sampling is done. For each sample, they have, you know, I would say, sample one. I would say, I have what kind of value-added work. So, VA1 might correspond to bending rebar, VA2 might correspond to tying rebar, okay, that is what you see here.

These are all the value-added categories, the non-value added categories, and the non-value added but necessary categories, and as when I make an observation for a sample, I would make something like this. I might be the third observation as this, this is the way I would go at the end of it, I would have sampled for my time period, which I want to do, and I will say total number of observations in each category is a, b, c and or I could add the total value-added observations, total non-value added and then in each category, I can get my percentages.

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Tour-based Sampling: Random Time

Link to Spreadsheet (download to edit): <https://tinyurl.com/yg8of8z>

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Work Sampling Outcomes

- Awareness of the extent of NVA & NVAN -> WASTE
- Detects where attention needs to be focus
 - To identify waste
 - Discuss root causes

Category	Percentage
NVA	47%
NVAN	35%
VA	18%

Activity	Percentage
Standing life	~20%
Tying rebar	~10%
Setting life	~8%

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Okay, I will show you an example, so here is something you might not be able to see that really clearly, but basically, this is an indicator of what we just showed with a filled-out form, and ultimately, there are percentages that will count. So, for example, here 18 percent is here, 35 percent, 47 percent, that is coming from the, your 18, 35 and 47 percent is what I got.

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Tour-based Sampling: Random Time

Link to Spreadsheet (download to edit): <https://tinyurl.com/ygRf8f8c>

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So, to do this, I have to observe the site, categorize as I see people what they are doing, at the end take a statistic of what is happening. Are there any questions on this? Because it is always causes some amount of clarifications are required.

Student: So, suppose the activity is long,

Professor: Long, yes.

Student: So, and the random time intervals that we are taking the samples.

Professor: Yes, so remember, this is not activity, this is a tour of a site. I am not waiting at an activity and waiting for a definition, I am walking my site and I am categorizing people as I am walking. We will come to the crew-based sample later. Okay, this is right now, a tour-based sample, I am walking the site, I am not worrying about activity, I am only, I know that, see, based on my initial planning, I know these activities are correct, that is why I am doing, these detailed categories are based on that. But I am not waiting for somebody to finish an activity or finish the work, or something, it is just a sample, okay. Any other questions?

Student: As like differentiating the NVAN and NVA

Professor: No, that is what. So, this is very relevant, you have to have an understanding on what is NVA and what is NVAN? Okay, you have to have a standard categorization, and in the Indian context, because we have helpers, what do helper mostly do?

Student: NVAN.

Professor: NVAN. Okay, so they contribute a lot to the NVAN on our sites. Okay, if I only had you know, skilled workers with minimum helpers, then the NVAN proportion would be reduced for us. But we have found over the years that this NVAN becomes right because we have the larger, we tend to have more helpers on our sites. Okay, more helpers than most of the other sites. So for the smallest thing they help us require move a tool, move this, move the wheelbarrow, move that, so they contribute to NVAN. Okay, but this categorizing between NVA and NVAN is important. Any other questions?

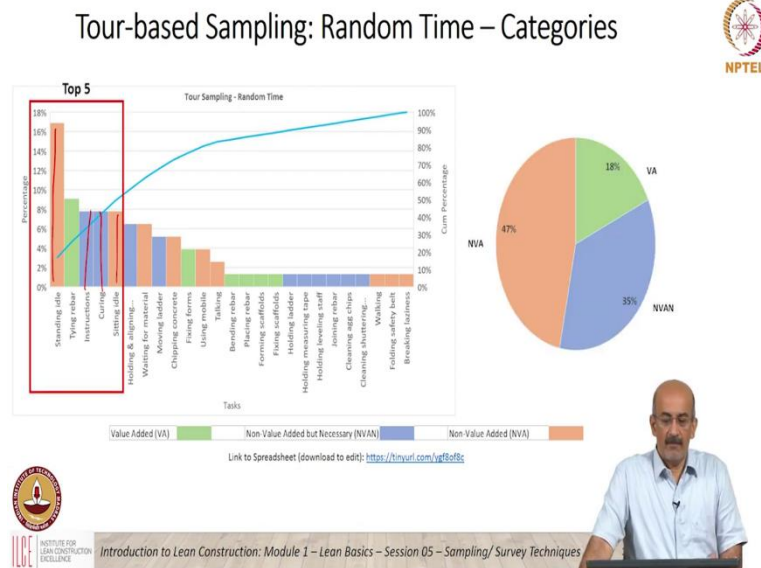
Student: Suppose the supervisor comes as the worker or anybody who is doing the work, they see the supervisor and improves.

Professor: Right, very good question, so this is, I wanted to take this, I was hoping this question would come up, so this is where we are talking about, even in the beginning, you know, remember, I said inform the workers, so if a worker is informed and they are going to change the work pattern because they are being observed. So there is a formal name to this effect, it is called the Hawthorn effect. Okay, because, so if somebody is knows they are being observed and they change the work pattern, okay, then your sampling goes wrong.

Now, so there is a, there is place or refer to this called the hawthorn studies. This is an impact that was observed many about 1930s when they tried to measure productivity, you know with using an experiment group and a control group. Now, the only the difference here is, yes, if the worker is idle because they want to be idle and they are purposely idle, this will have an impact. But if the worker is idle because there is no materials, there is no tool, there is no instruction, there is no work face, then what happens? There would not be any impact.

I mean, we have also seen, we go with a video camera, we put the video camera in front of the crew, the crew will start acting very busy for some time, then after some time, there is no bricks, what can they be busy with? They will be moving brick from here to here, here to here, so it does not add too much. And after some time, they also get used to the camera and say, anyway, they know what you are doing, it goes back to, so there might be a little bit of an initial activity increase, but we have seen it levels off, if the, if there are root causes, which are beyond the control of the worker, and most of the time there are root causes beyond the control, okay. But these are good questions, anymore?

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So when you break up all of that, you find this is where the categories work, so again standing idle was a large amount, tying rebar was this, you now get the idea, right? So you categorize into this, and this is what this is, how the activities broke up. And you can see standing and sitting idle are taken a large part of the non-value added, and taking instructions and curing.

Now, is curing value added, non-value added but necessary? How do you look at it? I can look at it, why do I want to put water and the cloth and this and that, can I put some kind of a curing compound and do it you know much faster without all this labour? Might be, people will say no more expensive. But looking at the number of labour that is involved in curing might be worth it today, because labour is not cheap. So, these are evaluations you have to do, okay. It is not a easy question to answer straight away, but very relevant.

So you can see now there is a detailed breakdown in categories, and if you want to go to this level, the question should be asked, why is people standing idle so much?

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Tour-based Sampling: Periodic Time



Date												
Tour #	Start Time			Stop Time								
Sample #	Time interval variation	Time (sec)	Time in Video (h:m:s)	VA			NVAN			NVA		
				VA ₁	...	VA _n	NVAN ₁	...	NVAN _n	NVA ₁	...	NVA _n
1		10										
...		20										
n		20										
Total observations												
Individual Categories (%)												
Three Main Categories (%)												

Link to Spreadsheet (download to edit): <https://tinyurl.com/vqf8d8z>



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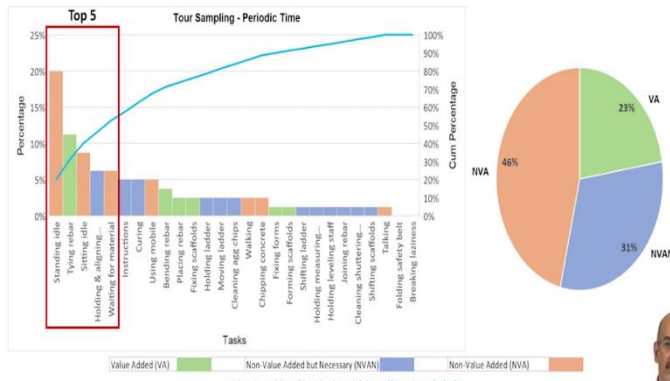
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Now we take the same approach, like I said, random is what we recommend, but sometimes people say look, I do not know how to do random, then we say okay, for at least till you get comfortable, you do periodic, that is you do not say I am going to watch it in a random thing and you will say that look, every probably ten seconds, you make an observation, just periodic, just for your comfort, it is not statistically valid, it is just for your, to get it and we have found in our classes when we do people, even if we say random, people invariably do a periodic, because that is somehow programmed, you have to untrain yourself to that. So just document it, you do a periodic.

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Tour-based Sampling: Periodic Time – Categories



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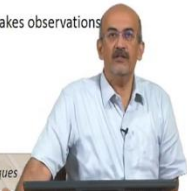
Tour-based Sampling: Comparison – Random vs Periodic Time



- Results of tour sampling, random time approach and periodic time approach is **very much close** in identifying the percentage of VA, NVAN, and NVA categories
- Random time approach** is recommended compared to **Periodic time approach** because it takes observations at random times, whereas periodic time approach requires systematic observations



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And you will find that, okay, you will find that there is not too much difference, I am going to kind of skip, so you will find very similar results here, and you will find that between random and periodic, there will be some difference because the sampling pattern is different, but generally, it is not, I mean, whether 18 percent or 23 percent, both are of value-added work is poor.

So, to bring about awareness into the project manager or into the site team that look your value added is so low or non-value added 35, 4, 5 percent error will be there based on the under-sampling error will be there but random is easier to do, I am sorry random is easier to do, if you know where how to randomize. Otherwise, also we have found this is okay, if you want to do this, that the difference is not too much that you can do it, there is not any for the kind of errors which we are not trying to do point one percent or point two percent, 4-5 percent error is part of our accepted error.

Anyone thinks that is too much in construction? For this kind of a tool, it is okay, even when we go in the productivity measurement system, how much error do you think there is daily progress report? It will be a similar error. This daily progress report accurate to the point one, cubic meter of measurement? No. So there are errors, and this level of error is acceptable, why do not we want to go for a higher, lower percentage of error?

Student: It will consume a lot more resources.

Professor: It will consume a lot more resources, and the outcome you get out of it is not going to be anything more valuable. So you have to go, this is basically this is why the heuristic and this aspect is okay. So, you can see this is what is contributing, use of mobiles all this is contributing to this product.

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Quiz



1. Consider the following statements and select the correct option: with respect to tour-based work sampling method

Statement 1: Random time approach is recommended over periodic

Statement 2: Periodic time approach is recommended over Random because it takes observations at periodic

Statement 3: Random time approach is not recommended over periodic

Statement 4: Periodic time approach is not recommended over Random because it takes observations at periodic

- a) All Statements are True
- b) All Statements are False
- c) Statements 2 and 3 are True
- d) Statements 1 and 4 are True
- e) None of the above

d) Statements 1 and 4 are True



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