

**Introduction to Lean Construction**  
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**Module – 01**

**Impact of PPC on Productivity, Key aspects, Advantages, The Necessary Conditions,  
Blocks – CPS, Summary**

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**S11.02: Impact of PPC on Productivity, Other Key aspects, Advantages of CPS, The Necessary Conditions, Blocks on the Road for CPS, Collaborative Planning Summary**

- Learning objective(s)
  - To Understand Impact of PPC on Productivity
  - To Understand Other Key aspects, Advantages of CPS
  - To Understand The Necessary Conditions, Blocks on the Road for CPS
  - To Understand Collaborative Planning Summary

Topics to be Covered Slide

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Now, we look at the next section, where we talk about the connection between PPC and productivity, some of the key aspects of CPS, advantages, the necessary conditions, and so on. So, the objectives for learning to understand the impact of PPC on productivity, to understand the other key aspects advantages and so on. Then what are the necessary conditions the blocks on the road and finally a summary of the CPS system.

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### Impact of PPC on Productivity

PPC	% productivity is better than budgeted
50%	4%
60%	16%
70%	23%
80%	29%

Prod = 0.530 + 1.095 \* PPC

After Dr. Glenn Ballard

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Dr. Glenn Ballard

- Data from BP refinery in Whiting, Indiana with multiple pipefitter crews working in six different areas over a number of months. A statistical correlation analysis was positive and statistically significant; the equation of the regression line drawn through the data points: **Productivity = 0.530 + 1.095 \* PPC in this case.**
- The lesson to be learned here is quite clear. If you want to **improve labor productivity**, **improve PPC**.
- But how does increasing PPC cause an increase in productivity? **PPC measures the reliability of future workload.** The more confidence you have that you will be able to work tomorrow where I am working today, the more willing you are to invest in planning and preparation.
- We know intuitively that **performance improves with planning and preparation.** A systematic cause for the low productivity in the construction industry is poor planning and preparation! - Dr Glenn Ballard (paraphrased)

This is a very very interesting and very important slide. Dr Glenn Ballard published this paper, he was doing a survey of pipelaying work in one of the places in US and when he plotted the connection between the PPC and the productivity at a large number of locations, he was able to see some kind of a correlation, the plots if you see were all lying around a particular line and then when he derived the equation of this particular line you can see the equation here, the productivity equal to all this multiplied by PPC.

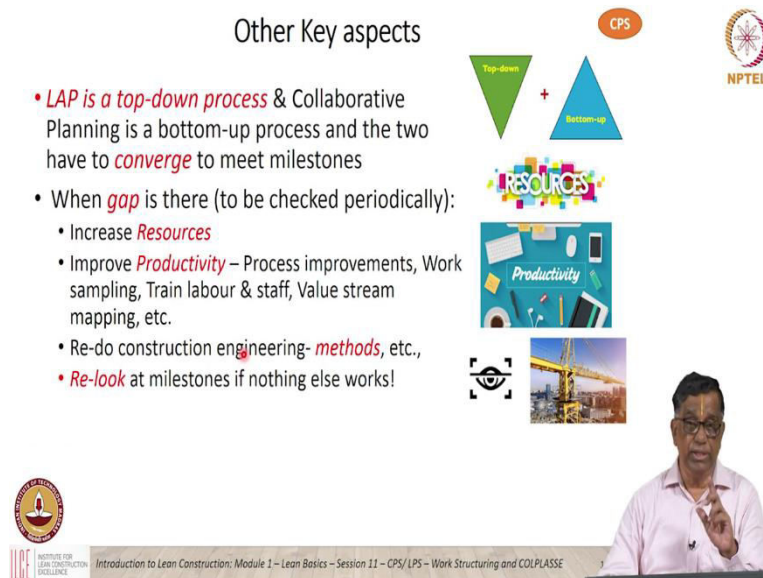
So, that means there is a direct connection between PPC and productivity, so that made him think. So, if you want to increase productivity that means the overall output at the end of the day, you need to focus on the PPC, and we all know what are the factors which affect PPC, good planning, good production system, people working together in a collaborative manner, all these.

So, if these are in place and if you are able to improve the PPC, then automatically your productivity increases, your production increases, the certainty level at the end of the day that again increases. So, there are multiple cascading advantages by focusing on a PPC to start with. So, very famous graph, very important, please think it over very carefully, and in your own projects, see if there is a linkage between PPC and your productivity. So, focus on PPC and your productivity is ensured.

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Other Key aspects

- *LAP is a top-down process* & Collaborative Planning is a bottom-up process and the two have to *converge* to meet milestones
- When *gap* is there (to be checked periodically):
  - Increase *Resources*
  - Improve *Productivity* – Process improvements, Work sampling, Train labour & staff, Value stream mapping, etc.
  - Re-do construction engineering- *methods*, etc.,
  - *Re-look* at milestones if nothing else works!



Some of the other key idea aspects to think about, your look-ahead plan is actually a top-down process, whereas your collaborative planning when you involve all the frontline peoples and start with the nitty-gritty, it is a bottom-up process. So, the need to properly converge to meet the milestones, when you look at only the look-ahead plans, we tend to get lost in the final fine print, we do not look at the bigger picture.

So, maybe once in a month, we need to tally, we need to cross check between the look-ahead plan and the overall milestone plan so that we do not lose out on the overall milestones. Because you know as a result of feedback loop between what is happening now and what we are going to plan later, sometimes we may tend to slip back from meeting the milestones, but we need to identify that as early as possible and take corrective action.

So, whenever you have a gap between the actual milestone date and the possible projected milestone date, we need to take some act corrective action. For example, you can increase the resources or you can increase the productivity by doing a number of factors, improve the process, keep on doing work sampling or value stream mapping, train your labor and staff, more intensively and there a number of ways in which you can ramp up the production and try to still meet the milestone date, which you have got which you got behind. You may have to redo the construction engineering or even change the methods at that particular time.

So, if nothing else works if you are going to be still behind the milestone you may need to talk to the clients to redo the milestone date, that may have other complications like contractual implications, but if nothing else works, there is no other choice. But we need to be aware from the beginning, that we need to correlate your actual progress, build the


milestone progress, and milestone requirements at regular intervals and take corrective action.

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**Summary of Advantages of CPS**

- Significant *change in mindset* of site people - more *collaborativeness*, more *openness*, more *supportiveness*, more *sharing*, readiness to *appreciate* & understand others' problems, ability to *solve problems collectively*
- Development of *Planning skills* in *Frontline Supervisors*
- Less waiting, more *Predictability/ Certainty*
- Increase in *PPC*
- Increase in *Productivity*
- *Savings in Cost & Time* over a period
- Substantial *rise in confidence levels* of site team to meet the Project's challenges!
- When projects are more predictable it becomes *easier to integrate* sub-assemblies created off-site- better SCM!

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So, there are many many advantages of CPS we have been seeing in the last few sessions. So, the main thing I would say is the development of the lean culture, there is a significant change mindset change in the people. People talk about something called the happiness quotient at the sites, traditionally construction staff if you look at them at the sites, they are all highly stressed out, they are not able to meet the targets that easily, and there are multiple demands, multiple theatres of operation, there are so many conflicting requirements and all that, but all that get properly streamlined when you are practicing lean.

So, and then the certainty level improves when you are practicing CPS as we have seen repeatedly. So, with all this, people tend to relax, they get into a happier frame of mind, and the so-called happiness quotient that improves when you start practicing CPS. And the lean culture that is a very very important aspect of practicing CPS, so people become more collaborative, they are more open, they are willing to share knowledge, they are willing to grab more support, they willing to give support and willing to take support from others.

Then the sharing, the kind of behaviour that improves, then people are able to appreciate and understand the viewpoint of others. In the big room, when you are doing look-ahead planning or weekly planning, you have to take some promises and you have to give some promises, that all that give and take that again improves the camaraderie, the dependingness on the other people, and finally improves the overall collaborative approach.

So, we are able to also learn how to solve problems in a collective manner, otherwise the frontline people, you know, they need to sit in their own, you know, cocoons are trying to solve the problems on their own, but with this approach you have the entire room of friends and colleagues who are willing to help you to achieve your targets and goals.

And the frontline people they develop planning skills which are not that there earlier and planning skills are very important in construction projects, because you get, the you tend to develop an overall appreciation of the entire work, the sequencing, how to you know do productivity analysis, and so on. So, the frontline engineer people they become better engineers, better construction engineers.

Then the predictability and certainty, that is a very fundamental point about CPS that increases considerably, the PPC goes up, the productivity goes up and the result of all this is there are savings in time, and savings in cost, that is been proven again and again, so CPS has got, this major advantage.

And in the overall sense, the entire project, there is a rise in confidence level that they can meet the targets, so there are, the stress levels come down people feel happier, and there are the overall, a better atmosphere at the site of performing the project. And projects become more easy to execute the stress levels, like I said are coming that is the biggest advantage I have seen by practicing CPS, people tend to become happier and become more confident in whatever they do.

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**NECESSARY CONDITIONS**

- Availability of *approved Fronts* with access
- *Previous work* to have been completed
- Staff & workers - required *Capability & Nos.,*
- *Data:* information, drawings, method statements, specs
- Right *equipment & tools and Nos.,*
- *Materials* and sub-assemblies available at the front
- *Shared understanding* between trades

**The Necessary Conditions**



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But in all this, how do we, what are the necessary conditions? The success of a CPS process does not happen just like that, the most important point is actually top management commitment, I have not put that here, but that is a very very important point. Then the minor things like you know, the fronts have to be available at the right time, the previous work should have been completed, that again happens automatically by the daily huddle process, then you need to have enough number of staff and labor, the right kind, the right numbers, then we need to have enough data, all the designs and drawings have to be in place, then the correct equipment and tools.

Normally, these things will be you know or taken for granted because of our constraint planning, you know, if you remember we are doing so many weeks, 6 weeks or 8 weeks or even longer than that or checking on the constraints, what can you know, what is required in the sixth week? What kind up drawings, equipment, labor? So, we are planning all these in upfront but then still these are prerequisites for achieving whatever we want to do in the current week.

Of course, equipment, materials and a shared understanding between the trades, because construction is a multi-disciplinary work for any particular work you require a number of trades to get together and collaborate you have formwork, rebar, concrete, conduits, embedment's, electrical work, mechanical, so many things, they all have to gel together, come together to make construction a success.

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**Blocks on the Road for CPS**

- Resistance to **Change**:
  - Reluctance from *frontline supervisors* to "plan" (being more used to "action"; and due to lack of knowledge / Confidence)
  - Not used to think beyond a couple of days! Reluctance to take time off from frontline to *sit and plan*
  - Suspicion** from management about frontline people "wasting time" to sit down and "Plan"
- Reluctance from **Planning Dept** to *let go* of planning to frontline people
- Reluctance to **involve subcontractors and vendors** in overall planning
- Distrust** to share information (Buffers, etc) with other Departments
- Lack of **Leadership, Organizational inertia**
- Lack of **Proper knowledge** of CPS

Icons: CPS, NPTEL, Project Planning, TRY, KNOWLEDGE, and a video inset of a speaker.

At the same time, we need to be aware of what can go wrong and try to take steps to prevent these you know, wrong things developing. For the first, one of the most important aspects is a

resistance to change. Any change of culture the people you know, are normally somewhat reluctant to the beginning, I have also found that, if you involve the HR people the human resources development people from time to time, they are able to conduct some training sessions to improve teamwork, collaborativeness, trust and you know all the other factors which go in for developing lean culture, that helps at in many places.

So, the frontline supervisors traditionally they are reluctant to do any planning as such, they are very happy standing in the front line and getting the work done, but here we want them also to do the planning for the weekly planning and the look ahead planning, so that becomes somewhat difficult for them.

And the top management again, the project manager, planning manager, people like that, they are not used to the frontline people coming to the office and sitting down to do planning, again that mindset has to change, and the planning department oftentimes you know, they do not want to let go of that traditional strength planning. So, they want to do all the planning themselves and are very reluctant to let the frontline people come and share the planning work.

And there is a lot of compartmentalization in projects, subcontractors and vendors are actually kept far apart, we do not get them to come and understand what exactly we are doing, that has to change, they need to be part of your overall planning in the collaborative planning system. And again, information sharing, the project manager and planning manager oftentimes they are the only people who are aware of what kind of buffers are available;



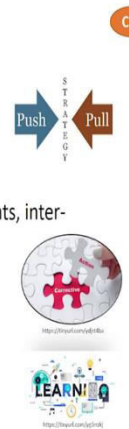
That is the one of the secrets in any project sites, what kind of buffer you have in cost? What kind of buffer you have in time? But that has to change, everything has to become transparent, when you are on a combined team like that everybody needs to know what is happening and everybody has to be on board.

So, there should not be any distrust and then the leadership are both at the company level under the project level, they are both very important. And many organizations they have a lot of inertia to change to let change happen, so that kind of mindset has to change and they need to become more open and more conducive to allowing change to happen. And of course, people need to have a proper knowledge of CPS, how exactly to put that in place? How to conduct that? And make sure it does not get derailed, that is all very important.

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### Collaborative Planning

- What is “Pull” process vs “Push” process?
- Who are the *Frontline Planners*?
- What is the *Best Planning Process* with *Flow* requirements, inter-dependence and need to cooperate?
- Where is the possibility for *Corrective action*?
- Where is the *Learning* from mistakes?



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So, summarizing some of the key points of CPS we need to of course you have been told several times, the difference between pull and push and who are the frontline planners who were earlier frontline supervisors, now they are becoming frontline planners and what are the best you know planning process which permits flow to happen, instead of focusing on activity level kind of detailing and then what are the possibility for corrective action.

When you have a number of feedback loops at the weekly level, daily level, then you need, you are able to improve on your production and we need to keep on learning from the mistakes, so lean is about continuous improvement. So, the continuous improvement will take place only when you study, what has gone wrong? Remediate all that and then keep on improving all the time.



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## Summary – CPS - Imp. Aspects

- Look-Ahead Plan (LAP)
- Constraint Analysis
- Weekly Pull Planning Session
- Daily Huddles
- Root Cause Analysis (RCA)
- Feedback Mechanism
- Matching with Milestone Planning
- Measures for Catch-up
- Continuous Improvement
- Inputs from First Planners as required
- Work Structuring



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Srinivasa, Abdulhamid (2008). – (2008) Lean Construction Principles and Methods – Michigan State University; Lean Construction Institute (2002)



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## Quiz

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1. Name 3 main advantages of CPS process
  - a) Development of Planning skills in Frontline Supervisors
  - b) Less waiting, more Predictability/ Certainty
  - c) Continuous Improvement
  - d) All of the above

**d) All of the above**
2. Which is the **most** important Enabler for successful CPS process:
  - a) Adequate resources
  - b) Strong Central Planning Department
  - c) Trust and openness in staff
  - d) Availability of work fronts

**C) Trust and openness in staff**
3. Which of the following are Problems for successful CPS process:
  - a) Lack of Trust in staff
  - b) Inertia to Change
  - c) Lack of Leadership Commitment
  - d) All of these
  - e) None of these

**d) All of these**



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## Supplementary Module

Link (to read and contribute)

<https://tinyurl.com/yf74v4yk>



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So, the various steps we have been seeing again and again, starting from the various charts, your milestone planning, phase planning, then all the look-ahead plans, concurrently we do constraint analysis, then we come down to the weekly pull planning sessions, that is very important and the daily huddles every day and we keep looking into the root cause analysis and there is a feedback mechanism from day to day or from week to week.

And then we need to match with the milestones once in a while and if you are lagging behind you need to have measures for catching up and continuous improvement is the main mantra, the main aspect to be kept in mind. Then input from the first planners for making this improvement all the time and all these start from the work structuring. So, these are the major aspects of CPS and you know hopefully, you have all understood all that and will be able to practice this in your sites.