



INFRASTRUCTURE  
CLIENT GROUP

# Production Management in Design and Construction

ICG Guideline, 2015

# Improving performance through collaboration



Andy Mitchell - Chairman, Infrastructure Client Group

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TAMARA J ERICKSON, Harvard Business Review Blog May 2012

# Improving performance through collaboration

The UK is facing new challenges in developing our national infrastructure. Our networks are mature and need renewal. Infrastructure is becoming more integrated and reliant on technology to deliver improved services. And in the aftermath of the financial crisis of 2008 we have limited resources to invest in new infrastructure and concerns that infrastructure services are becoming unaffordable.

It is evident that our traditional approach to delivering infrastructure projects is inefficient and often fails to achieve the outcomes that are promised. In 2010 IUK's Infrastructure Cost Review showed that the cost of building roads, railways and other infrastructure in the UK is as much as 40% greater than in comparable European economies. And studies by Oxford Global Projects suggest that proposals for urban rail projects typically overestimate passenger demand by 100%.

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There is a growing consensus that to meet these challenges and provide the infrastructure we need to sustain economic growth and public services we have to find new ways of working that will unlock innovative capacity within our supply chains and drive out waste in our processes. In short we have to build on the work of Sir Michael Latham and Sir John Egan and develop collaborative approaches to investing in our infrastructure.

Collaboration enables infrastructure companies to engage with their suppliers and stakeholders to unlock innovation, reduce waste and improve reliability in project delivery. Collaboration is a journey for all of the participants. We know that by using collaborative planning and production management techniques we can improve plan reliability and reduce task and project duration. And in time these can lead to companies and their suppliers developing collaborative organisations, integrating business processes and delivering sustainable improvements in performance. It can be a long journey but the potential rewards are substantial.

This technical note has been produced by members of the Infrastructure Client Group (ICG) under the ICG's collaborative project teams programme. Based on the ICG members' own experience it describes how collaborative methods can be used to improve production management in the design and construction of infrastructure projects.

Andy Mitchell – Chairman, Infrastructure Client Group

# Introduction

This guideline shows how infrastructure companies can reduce the cost of projects and the time it takes to deliver them by collaborating with their suppliers in managing design and construction. Production management achieves these outcomes by involving all parties in planning the work, removing barriers to efficient execution, measuring performance and learning from experience. The result is more innovative work programmes and more reliable production processes. These are simple practices that are rarely applied to construction projects in the UK.

There are significant shortcomings in traditional approaches to planning and managing construction. Project managers prepare programmes with limited input from the people who will do the work and then push work through design and construction, often starting tasks that cannot be completed. Studies have shown that on typical construction sites:

- About **50%** of the tasks that were started could not be completed as planned<sup>1</sup>
- As a result up to **50%** of construction man-hours were not productive<sup>2</sup>.

These studies have led to new approaches to production management that have been used successfully on infrastructure projects around the world. They include proprietary systems like Last Planner<sup>3</sup> as well as systems that infrastructure companies have developed for their own use. Evidence from Highways England and Anglian Water Services suggests that production management can reduce the costs of projects and their construction programmes by more than 10% and at the same time improve suppliers' productivity.

In this guideline we set out the principles and the terminology of production management as applied to the design and construction of infrastructure projects. We describe the key processes with examples from projects in the UK. And we suggest how companies can get started in using production management in their own programmes.

We are grateful to the following organisations for their contributions to developing this guideline:



# Acknowledgements

## Production Management Team

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# Principles and terminology

There are many different approaches to production management in design and construction each with its own processes and terminology. But underpinning all of them are three principles that define production management:

- **Collaboration** – production management is done with the companies, their supervisors and the people who will execute the work in the design office and on site.
- **Transparency** – the processes and outputs are transparent and made available to everybody involved in the project through the use of visible planning methods and performance metrics.
- **Improvement** – production management engages the workforce in resolving problems and improving performance.

**Production management complements traditional project management.** It takes the work packages and milestones that project managers define and constructs around them viable plans for executing the work and transparent processes for measuring production and improving performance.

**Project management is based on a hierarchical structure with the project manager at the apex.** The project manager plans the project, allocates work to the contractors, monitors progress and directs the contractors when plans have to be changed. Design and construction are sub-contracted to suppliers who plan and manage their own work beyond the sight of the project manager.

**Production management works within this structure but from the outset engages the designers and suppliers in planning and managing the project.** This is done using the collaborative planning and production management techniques described in this document. By engaging the people who will do the work in the planning of the work we ensure that plans are based on current knowledge and that the workforce is committed to them. The production management processes enable the workforce to adjust their plans to make best use of the resources available rapidly identifying problems and solving them.

In the following sections we describe the five basic steps of production management in design and construction and make some practical suggestions as to how you can get started:

Collaborative  
Planning

Making  
Ready

Production  
Control

Team  
Briefing

Performance  
Improvement

GETTING  
STARTED

# Step 1 – Collaborative Planning

*Work together to plan the job*

The process through which infrastructure companies and their designers, contractors and suppliers work together to analyse a project and develop the optimum sequence of activities for delivering it. The process creates detailed execution plans from key milestones and identifies interfaces and other features that will be critical to successful project delivery. The plans are based on the combined knowledge of all of the companies involved in the work and are thus more likely to present the best approach and ensure the most reliable outcome.

**Also Known As:** Collaborative Mapping, Process Analysis, Interactive Mapping, Brown Paper Planning

## Key Features:

- The people responsible for doing the work plan the work
- The process is collaborative – everybody in a room working together to develop the plan
- It is done with simple tools – brown paper and coloured sticky notes

## Benefits:

- Interfaces between tasks and suppliers are made explicit
- Creates understanding, ownership and commitment to deliver the plan
- Greater opportunities for innovation



## Click for:

- Case study 1: [Stations stabilisation programme, London Underground](#)
- Video: [STAKE Academy - The journey so far, London Underground](#)



# Step 2 – Making Ready

*Identify everything needed to complete the work*

The process through which the people responsible for a section of the project plan it in detail and identify all of the constraints that have to be resolved before the work can begin. The process typically focuses on one section of the project and looks 4-8 weeks ahead with the first 1-2 weeks planned in considerable detail to ensure it can be completed without risk of disruption. The exercise is then repeated at intervals of 1-2 weeks to provide a rolling programme with confidence in the planning of the work that is about to begin. It is common for planning boards to be used at this stage to facilitate the regular updating of the plan.

**Also Known As:** Stability Criteria, Constraints Analysis, Look-ahead Meeting, Plan for Stage Meeting, Stability Review Meeting

## Key Features:

- The planning is focussed on the near future (4-6) weeks
- The process identifies constraints to completing the tasks in the plan.
- The plan is visible and all parties commit to it.

## Benefits:

- All constraints to complete tasks are identified
- Tasks are not released to production until all constraints have been removed
- Everybody commits to the plan



## Click for:

- Case Study 2: [Cambridge Water Recycling System, Anglian Water @ One Alliance](#)
- Video: [Track Partnership – Hainaut Blockade](#)



# Step 3 – Production Control

*Record progress and adjust the plan*

The process usually takes place daily in construction and less frequently in design. The supervisors responsible for the sections of the work meet together to assess the work completed in the previous period and adjust the plan for the next period allocating the space and common resources they will need. They check that everything is in place to enable the tasks planned for the next period to be completed and they gain commitments from each other to complete their parts of the work. Production control meetings are brief and usually take place in front of the planning boards.

**Also Known As:** Last Planner, Weekly Work Planning, Stand Up Meetings, Short Interval Planning, Production Management

## Key Features:

- The process begins with an assessment of what has been completed in the last shift
- It then addresses the plan for the next shift, checking that everything is in place for the tasks to be completed and adjusting the plan
- Reasons for non completion are recorded and input to performance improvement

## Benefits:

- Work is planned and integrated at gang level
- Plans are reset daily on actual conditions and performance
- All interfaces identified and discussed
- Issues causing low productivity can be addressed on a daily basis



## Click for:

Case Study 3: [“5 at 5” M1 Junction 19 Motorway Improvement Scheme, Skanska](#)

# Step 4 – Team Briefing

*Brief the people who will do the work and listen to their feedback*

At the start of every shift the supervisor meets with the people doing the work to explain the tasks to be completed, the sequence of working, equipment and other resources that are available to support the work and the key risks to health and safety. The supervisor also gets feedback from the team on the proposed methods of working and on their experience of safe and efficient work practices. Team briefings are usually delivered in a short meeting with a standard agenda and with drawings, flip charts and other materials available to support the briefing. It is becoming common practice for team briefings to use BIM models on computers to demonstrate work sequences.

**Also Known As:** Pre-Shift meeting, Crew Briefing, Shift Briefing, Toolbox Briefing, Standup Meeting, Daily Task and Safety Meeting

## Key Features:

- The plan for the next shift is communicated to the people who will do the work
- Final check to ensure everybody understands the plan and that the work can be done safely and efficiently
- Feedback from the workforce to inform future planning and performance improvement

## Benefits:

- Engages the expertise of everybody involved in the task
- Everybody knows what they have to do
- Enables “if not safe – don’t do it”
- Learning from the workforce’s experiences



## Click for:

- Case study 4: [The use of technology in briefings, Skanska](#)

# Step 5 – Performance Improvement

*Simple steps that add up to continuous improvement*

The principal cause of inefficiency in design and construction is uncertainty. People are asked to begin tasks that cannot be completed because all of the resources are not in place or dependent tasks are incomplete. Consequently on typical sites only about 50% of the work scheduled actually gets done to plan. Production management improves performance by measuring and improving the reliability of design and construction processes. It embeds performance improvement in the production management cycle and gives supervisors and the workforce timely and accurate performance metrics and the authority to act on them

**Also Known As:** Continuous Improvement, Lessons Learned

## Key Features:

- A regular meeting to assess the work that has been done and address performance issues
- KPIs and analysis of current performance issues displayed on boards for all to see
- Active problem solving and engagement of the workforce drive performance improvement

## Benefits:

- Improvement activity is based on data derived from step 3
- Everybody involved in improving performance
- Creates culture of continuous improvement



## Click for:

- Case Study 5: [Performance improvement in Area 13 of the Highways England network](#)

# Getting Started

Production management is a good place to begin the journey towards improving performance through collaborative working with designers, contractors and suppliers. The methods described in this guideline can be used within traditional project teams and some positive results can be obtained without disruptive changes to project management practices. Before using production management methods on a project it is sensible to get advice from people who are already using the methods and from organisations that can provide technical support and training as you get started and gain experience and confidence. It is also helpful to get involved in the various communities of practice and arranged events in both the UK and overseas. These are details of a few organisations that can help you get started:

## Institution of Civil Engineers

Organisers of ICG events.  
[charles.jensen@ice.org.uk](mailto:charles.jensen@ice.org.uk)  
[www.ice.org.uk](http://www.ice.org.uk)

## Lean Construction Institute UK

[derek.drysdale@leanconstruction.org.uk](mailto:derek.drysdale@leanconstruction.org.uk)  
[www.leanconstruction.org.uk](http://www.leanconstruction.org.uk)

## Lean Construction Institute USA

[www.leanconstruction.org](http://www.leanconstruction.org)

## Click for video clips:

- Video 1: [Lean Construction :: A Case Study at Monmouth College](#)
- Video 2: [STAKE, TfL](#)
- Video 3: [Drees & Sommer - Lean Construction Management](#)

## References:

1. Ballard G and Howell G A (2003), *Competing Construction Management Paradigms*. Proceedings of the 2003 ASCE Construction Research Congress, Honolulu, Hawaii.
2. Hawkins G (1997), *Improving M&E Site Productivity*. BSRIA Technical Note TN14/97
3. Ballard G (1994), *The Last Planner*. Northern California Construction Institute Spring Conference, Monterey, California.

## Click for case studies:

- Case study 6: [The first installation of a modular Mk3 crossover in four midweek night 8 hour possessions on a main line commuter route at Tottenham Hale](#)