CS21641

BIM 360 Plan – Practical Implementation for Lean Construction

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Learning Objectives

- Understand the benefits of the Last Planner Principals
- Understand the process of LPP
- Understand the benefits of BIM 360 Plan
- Understand the potential value of BIM 306 Plan

Description

The class will cover the 'Last Planner' Principles developed by the Lean Institute and how the software supports this principle. The benefits of adopting the Last Planner principles such as increased reliability, time and cost saving, less wastage of materials and greater utilization of plant. The benefits are further enhanced by collaboration with the supply chain where they can review their elements of a plan in line with main contractors and feed into 360 Plan streamlining interactions. The gains made through BIM 360 Plan to this process such as staying in the field longer, reduce time spent compiling reports in the office, improve Planed Percentage Complete (PPC) with accountability for lost time weekly allowing for root cause analysis to aid in targeted solutions and provide a platform for detailed whole project as built data. Finally the class will also briefly discuss the benefits of BIM 360 Plan supporting construction claims and its use to minimize disputes.

Your AU Expert(s)

Phil Richardson has worked across manufacturing, consulting and construction gaining 18 years of experience with several modelling packages. In his current role for BAM Nuttall in BIM deployment he supports the projects throughout with training and development of the staff. The BIM Deployment team is integral to BAM Nuttall's strategy of continually developing better Lean Construction processes in harmony with BIM technology to provide the best outcomes for the projects and value for the client.

Adam Holmes joined BAM as a trainee engineer in 2001 and has progress through the engineering disciplines. Adam is a Technician Member of the Institution of Civil Engineer (EngTech MICE), and member of the Chartered Institute of Arbitrators and (MCIArb). Having worked on a variety of civil engineering contracts, Adam is able to bring his knowledge and experience to construction planning ensuring detailed tasks are identified and monitored. Adam already adopted last planner principles on the projects he was responsible for which made him an ideal candidate to assess the impact and value of BIM 360 Plan.

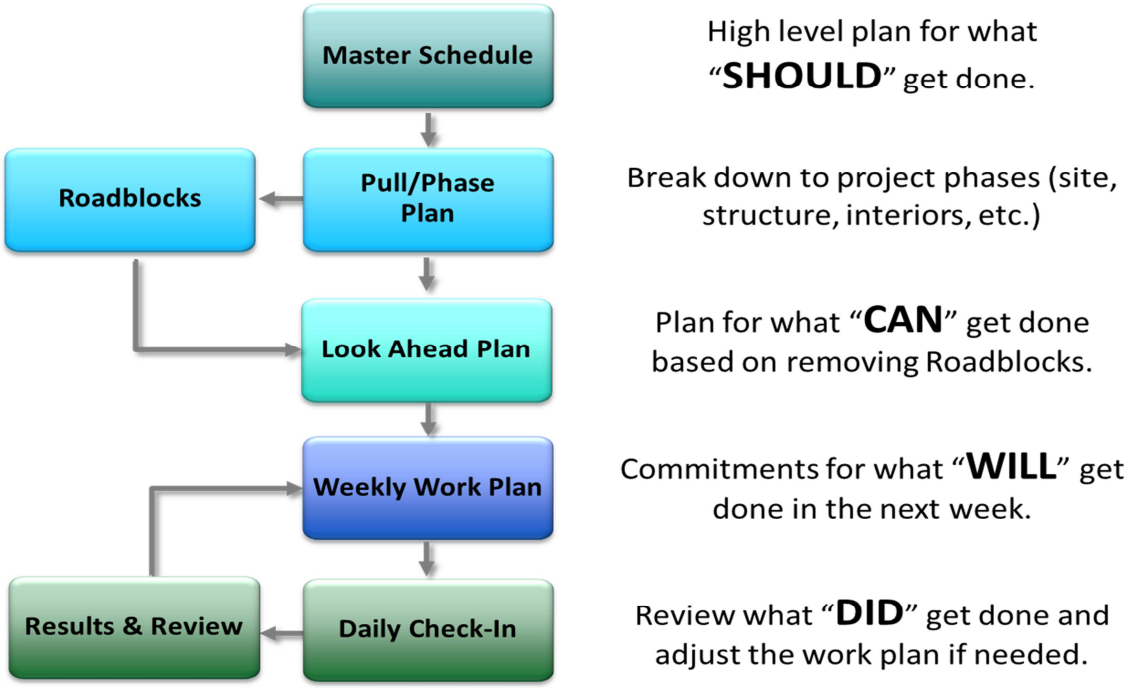
The Last Planner Principles

Developed by the Lean Construction Institute, the Last Planner System, also known as lean production planning, is a key system in the lean construction toolkit which involves requiring commitments to schedules by all project team members. The five key elements of this system shown below are:

- Review the master schedule or contract programme
- Pull planning – what do we need to do to achieve master schedule dates working back
- Make work ready (look-ahead) planning
- Weekly team meeting to communicate the information and obtain commitment to achieving tasks
- Regular monitoring of progress

Regular reviews of planned percent complete scores, root causes of incomplete activities and missed targets create opportunities for continuous improvement through learning.

This process is particularly beneficial in the construction industry where tasks can be influenced by a number of internal and external factors.



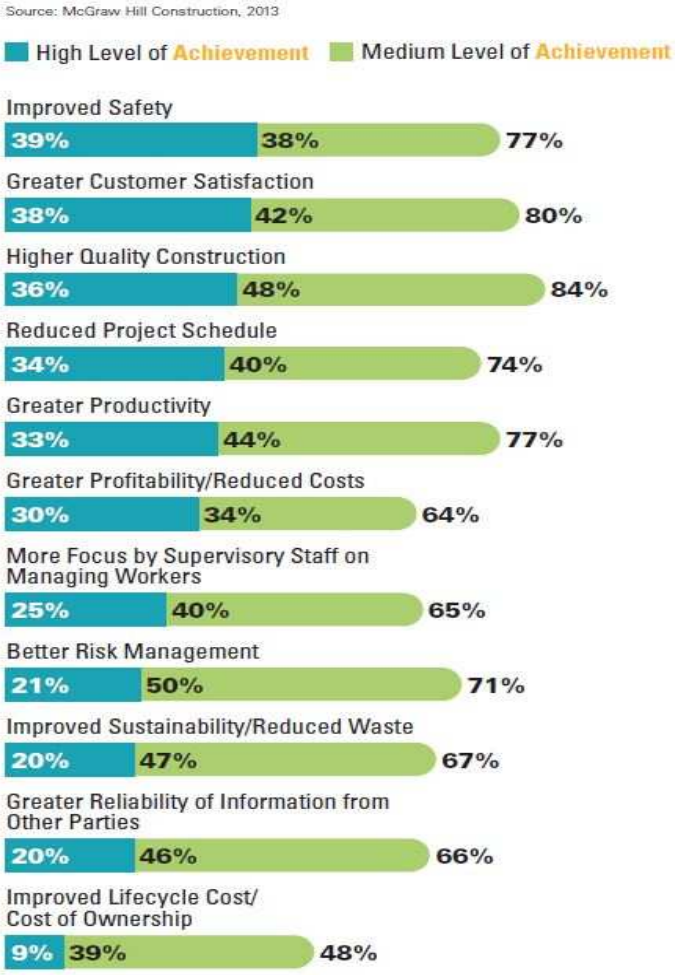
The last planner is not the planning engineer or the site manager; they are the person who has the influence to commit to completing a task at the given time. Typical examples could be the sub-contract supervisor, the site engineer or the procurement manage

Documented Benefits

A 2012 literature review (1) of 26 international project-based case studies found that last planner system:

- Increased work flow reliability
- Improved supply chain integration
- Reduced project delivery or production time
- Improved communication among project participants
- Reduced firefighting or fewer day to day problems
- Improved quality of work practice onsite
- Enhanced managerial practices in construction projects
- Expanded knowledge and learning among project teams
- Reduced stress levels on construction sites

A 2013 McGraw Hill survey (2) found the results displayed below. Danish research (3) on project comparisons within a single company showed 65% fewer accidents and up to 70% less sickness absence on Last Planner managed construction sites.



Proactive planning offers considerable opportinuty to address issues ealry which is preferrable to reactive planning where opportinities may have already passed.

The Last Planner Process

Implementing the last planner principles requires regular co-ordination meetings to support collaborative planning. These meetings provide the whole site team, including supply chain partners the opportunity to learn and discuss site wide issues and requirements for meeting the master programme.

Using the pullback planning process, all the tasks that need to be completed to meet the master programme dates can be identified and the required workflow can be discussed. Discussions typically include process, outputs, health and safety considerations and quality requirements. From this, tasks can be assigned to the last planner who can then commit to achieving them. This provides clear identification of tasks and prevents overlap with role responsibilities.

FIG 1. WHAT THE LAST PLANNER PROCESS LOOKS LIKE

This process provides greater awareness of the global requirements and project goals which help build a stronger team as individuals feel included and empowered. Each person can contribute to the discussions and provide their own thoughts. This inclusiveness provides the leanest overall solution and learning opportunities for junior members of the team.

At the weekly meetings a review of progress for the previous week is carried out. Activities that were not completed at the required time are identified and the root causes discussed

How BIM 360 Plan Support the Last Planner Process

BIM 360 Plan supports the LPP in a variety of ways by encouraging short term collaborative planning. By encouraging the flow of information, engagement of the team and obtaining firm commitment to performing tasks, proactive planning is encouraged. As discussed above, the provides for Lean construction practices

The key functions of the software are:

- Provides a digital version of 'sticky notes' and information can be viewed in a number of formats
    - **Gannt format** – a traditional view of activities against dates
    - **Swim Lane** also known as time chainage. This is practically useful to visually check areas of congestion
    - **List View** which aids sorting and filtering of activities similar to Excel

- Various customisable functions to suit the business or project such as:
    - Crew names and colour coding for visual identification
    - Type and amount to possible Root causes
    - Location coding
    - Calendar and Holiday options
    - Custom views

- Simple colour differentiation to visually distinguish activities that have been
    - complete,
    - committed,
    - incomplete

- Add user level functions 3No – admin, user, view

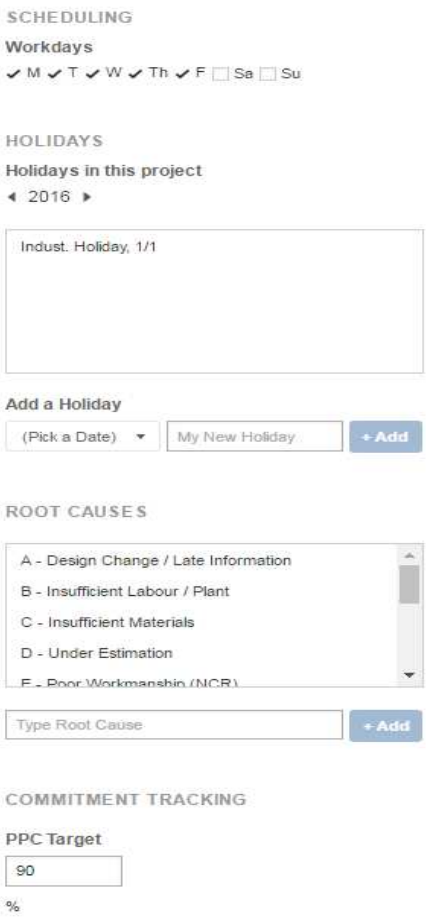


FIG 2 CUSTOMISABLE SCHEDULING, HOLIDAYS AND ROOT CAUSES

- Simple and intuitive to use – can be taught quickly
- Can be viewed on IPad's
- Progress can be updated and reviewed on a daily basis in real time
- Information can be filtered to provide focused viewing – options include:
  - A-Z Column Filtering
  - Filtering of time periods
  - Filter crew activities
- Various report function captured by the software:
  - Root Cause Analysis
  - PPC Scoring
  - Activities number

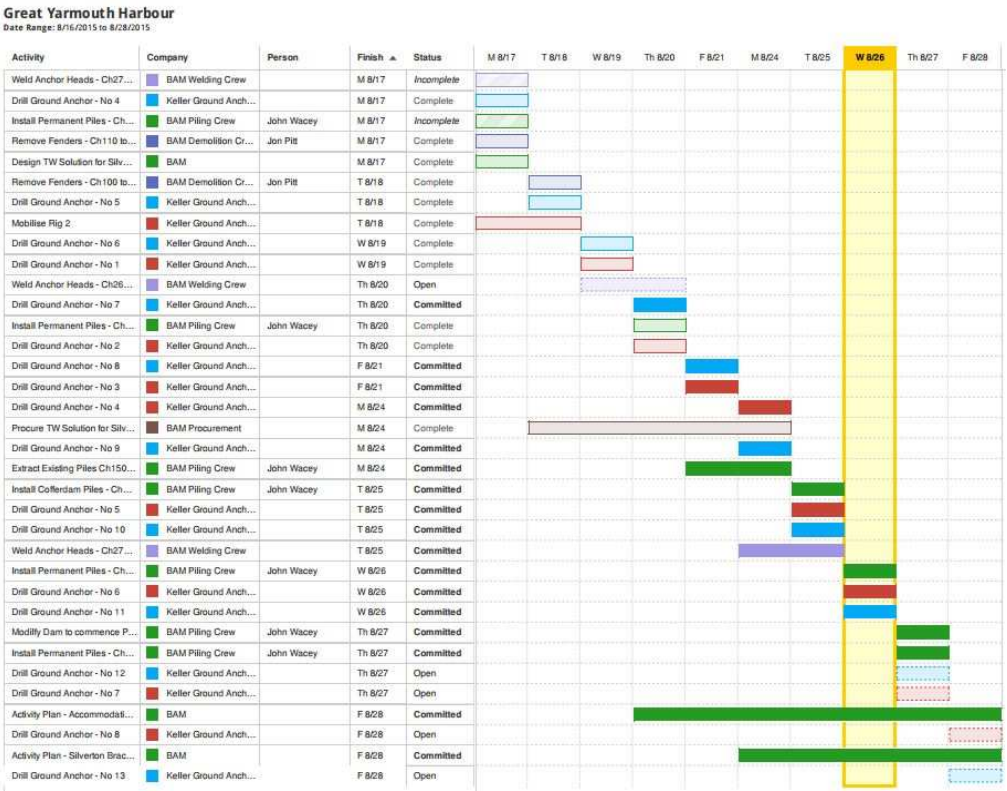


FIG 3. GANNT VIEW SHOWING COLOUR CODING OF VARIOUS CREWS.

The software requires each workflow task to be added to the software. The process of added a task is simple and can be added through a series of drop down menus or imported via an excel spread sheet.

Once the task is added, an ‘Open’ status is assigned until the task is ‘committed’ once a task is committed, it must ultimately marked as completed or incomplete.

A completed task will be recorded as a positive score on the Planned Percentage Complete (PCC) metrics data.

For each incomplete task, a root cause for the non-completion must be selected from the drop down menu populated in the set up. At this stage, the software allows for additional information to be added and the task to be rescheduled.

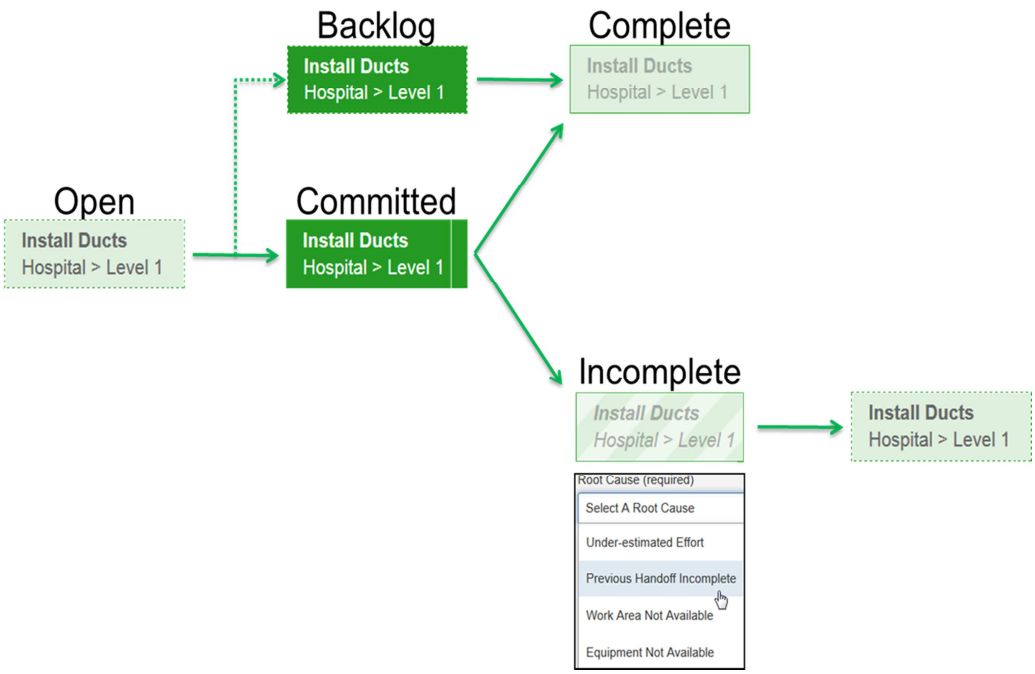


FIG 5. REPORT FUNCTIONS SHOWING A SUMMARY OF THE DATA CAPTURED

The BIM 360 Plan provides easy require of the PPC score and root cause analysis. This allows the team to identify common causes. Once these root causes are analysed, control measures can be implemented to mitigate on going issues.

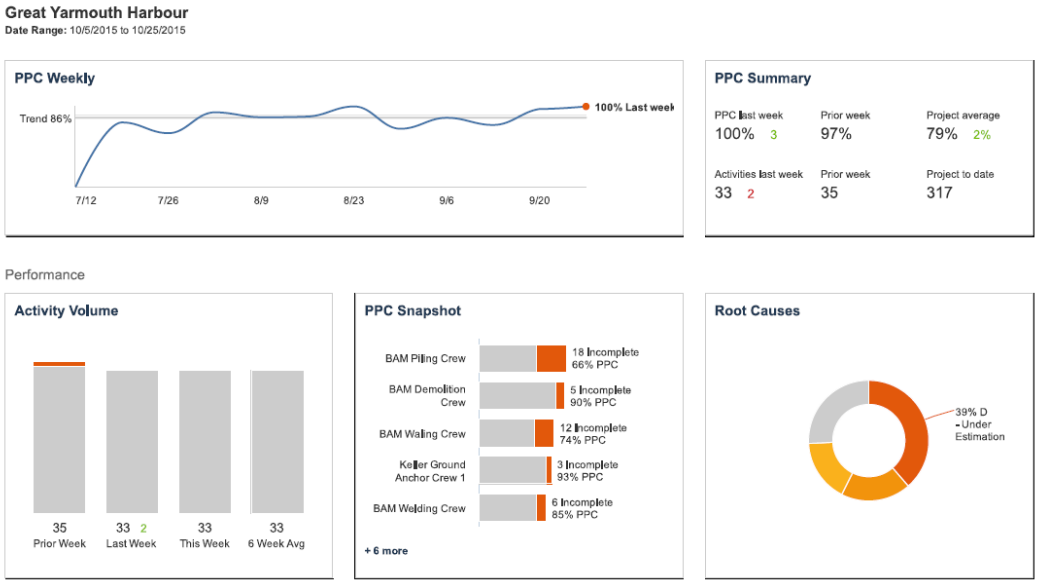


FIG 5. REPORT FUNCTIONS SHOWING A SUMMARY OF THE DATA CAPTURED

The development of the BIM 360 Plan is still in the early stages of development. We would like to see further enhancements with greater integration with other Autodesk software suites . This would further enhance the benefits of BIM 360 Plan.

Case Study Great Yarmouth, UK

A joint venture between BAM Nuttall and Mott Mcdonald were awarded the £17m design and build flood defence on the river Yare in Great Yarmouth. Due to the poor condition of the existing quay, the defence was in danger of catastrophic failure which had the potential to flood a large number of residential and commercial properties. The project was awarded by the Environment Agencies (government body) through their 'Water and Environment Management Framework'

The project consisted of 505 linear meters of steel sheet piling over 4 sections of quay. The steel sheet piles were anchored using a combination of methods. Time constraints were imposed through the contract for each phase.

FIGURE 6 – AERIAL PHOTO ILLUSTRATING THE LINEAR AND CONFINED NATURE OF THE GREAT YARMOUTH SITE.

The project was a ‘linear’ scheme where gangs would be dependent of predecessor crews staying ahead. Key tasks involved:

1. Installation of steel sheet piles
2. Demolition of existing capping and apron
3. Excavation and installation of a waling beam
4. Installation of Ground Anchors
5. Installation of Drainage
6. Construct new capping beam and apron

Working space was very limited and movement of large items of plant and marine based barges had to be co-ordinated between all disciplines. The communication of these moves where discussed at the weekly meetings.

FIG 7. SITE PHOTO SHOWING THE CONGESTED NATURE OF THE SITE AND THE POTENTIAL FOR DELAYS ASSOCIATED WITH A LACK OF COORDINATED PLANNING

Through the BAM / Autodesk agreement, BAM choose the Great Yarmouth Project to adopt the use of BIM 360 Plan in the context of a pre-commercial release pilot on an initial trial period of 10 weeks. The BAM Nuttall team at the Great Yarmouth Harbour project had observed the following benefits in 4 key areas:

1. Reinforces last planner principles & encourages behaviour necessary for last planner system to function correctly
2. Provides clear and automated tracking of information resulting in:

- Long term planning reliability improvements:
    - Provides accountability / visibility of short term programmes to other users (ie it demonstrates project manager that planners are doing their tasks and gets all crews the latest information for accurate coordination)
    - Collates root causes in one central and easy to view / review dashboard for quick feedback and learning
    - The report function provides clear graphic illustrating the PPC, which encourages inter-gang/subcontractor commitment to achieve target PPC
- Time savings
    - Provides an accurate, detailed as-built programme in one form / one screen (against numerous excel versions of the same as-built information)
    - Saves 1.5 - 2 hour of reporting time per week, or up to 10% of a working hours (copying, scanning, saving and storing) by automatically generating as-built programme
    - Gives entire project team immediate access to latest version of the detailed weekly plan and 4-week look ahead plan, reducing time spent looking for correct information
    - Would save many hours and provide accurate information if dates and activities needed to be reviewed in a potential future claims situation
    - Increase level of role responsibility so that each member of the team knows they tasks without overlap between staff

1. Ease of use and intuitive - more user friendly than excel, and it allows simple iPad viewing/updating on daily basis
2. Future potential for information connection with other information management systems

During the weekly meetings, I would often hear ‘well if you are going to do that then, then I will do that at the same time and…..’. This would always result in the more efficient utilisation of resources.

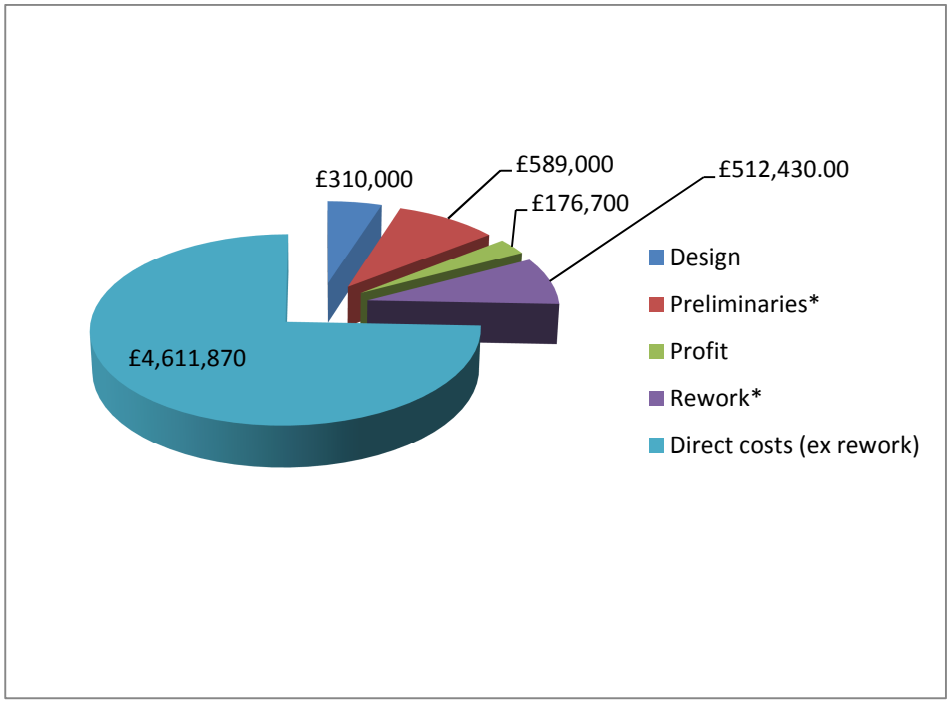
The Value of BIM 360 Plan

Although the value of BIM 360 Plan is clear, putting a figure to the potential saving is subjective as no baseline to compare against possible. The value is likely to be different for each industry and each project.

- Reduction of unnecessary rework costs, due to improvements in quality through better coordination, clash detection and earlier communication/resolution of onsite issues.
- Reduction in overall programme and preliminary costs, due to less overhead costs as time on-site becomes shorter.

Hypothetical cost breakdown and Quality/Schedule reduction for Great Yarmouth Project

Project Characteristics - Value	Input
Contract value for total project	£6,200,000
Percent of project value attributed to design	5.0%
Project Value attributed to design	£310,000
Project value attributed to construction	£5,890,000
Percent of construction value attributed to general conditions (preliminaries)	10.0%
Project value attributed to general conditions	£589,000
Percent of construction value attributed to profit or fees	3.0%
Construction Fee (profit margin)	£176,700
Project value attributed to direct costs (labor, materials, equipment & subcontractor costs)	£5,124,300
Percent of Project Value attributed to Rework	10%
Project value attributed to rework	£512,430



**COST ITEMS WHICH CAN BE REDUCED THROUGH EARLIER DELIVERY AND HIGHER QUALITY*

Construction Field Management Productivity Gains	Default	Override
Users of BIM 360 Plan		2
Average hours worked per week		45.0
Average fully burdened hourly rate		£22.2
Number of Construction Months		12
Anticipated efficiency gain via BIM 360		10.0%
Construction project hours saved		468
Associated project savings		£10,390

The estimated total cost savings depend on how we wish to interpret the 10% efficiency gains for 2 users:

A. If purely in reduced labour - £10,000 can be saved
B. If the 20% efficiency gain is invested in schedule acceleration through better planning, and 10% improvement achieved (~£30,000) and 1% rework reduction (~£50,000), then a total of ~£80,000 could be saved.

Construction Project Schedule Acceleration	Default	Override
Project value attributed to general conditions (field offices, security, fencing, trucks, etc.)		£589,000
Percent of general conditions that are variable (time-based) vs. fixed overhead		50.0%
Variable general conditions costs		£294,500
Number of Construction Months		12
Anticipated percent acceleration of construction project schedule		10.0%
Anticipated number of weeks projects will be accelerated		5.2
Associated project savings		£29,450

Improved Quality / Reduced Construction Rework	Default	Override
Project value attributed to direct costs (labor, materials, equipment)		£51,243,000
Cost of rework as a percent of direct costs		10.0%
Anticipated percent reduction in cost of rework via BIM 360		1.0%
Associated construction cost savings		£51,243

Note: This report only presents a quantification of Cost savings. For a full ROI calculation, software and hardware costs need to be considered:

ROI = Total Cost Savings - (Software + hardware costs) /(Software+hardware costs)

Conclusion

A common thread through all lean philosophies is planning and leadership. By adopting last planner principles supported by BIM 360 Plan, effective collaborative planning is achieved and performance metrics are captured.

Putting a value on the software is subjective and will vary between differing stages of construction and differing types of projects. However, based on our experience, it is difficult to see how significant value is not added by adopting the same approach as we did at Great Yarmouth

Reference Source

1. http://constructingexcellence.org.uk/resources/lean-construction/
2. Autodesk BIM 360 Plan deployment training notes (M Moran)