



Piloting the Deployment of ISO18404 in the Construction Sector

PROJECT REPORT



Project Dates:

2017 to 30th April 2019

Project Partners:

Gilbert & Goode Construction, Cornwall
Construction Training Group and
Acorn Blue

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PROJECT SUMMARY

Background to the project

Gilbert and Goode was established in 1972 and is based in Cornwall UK. They deliver a range of contracts from major projects to minor works and maintenance. In 2005 they were acquired by a registered social landlord, Ocean Group to expand their traditional and contracting business, and also to construct the group's housing developments. They are a commercially focused contractor but with a social purpose, returning any surplus profit to the parent group for re-investment for the public good.

In 2018 turnover was approximately £25million with around 70 employees. Growth to £40million is forecast in the next two years.

Acorn Blue is an independent development and regeneration specialist that has, for many years, successfully created a range of residential-led refurbishment and new build schemes.

In recent years in Cornwall it has also began to undertake main contractor responsibilities for its own developments.

The Motivation for Lean Transformation

At Gilbert and Goode there was a need to attack the cost base of new build housing and drive both qualitative and quantitative improvement in a structured manner. They saw the opportunity to improve the productivity of the business by driving out the inherent waste in construction operations thus increasing the company's competitive advantage and delivering greater returns to the parent Group, Ocean Housing. Furthermore Cornwall, like most of the UK, suffers from a lack of skills and capacity and by working with the supply chain and offering them a platform on which they could perform and make money, more could be gained from the limited resources available and the best talent could be attracted to the company's sites. They began to encourage the adoption of lean techniques within the company via knowledge transfer and in 2016 appointed a consultant, to help accelerate these efforts. An initial Lean awareness workshop was held with about 20 staff. This was followed by two pilot projects predominantly using the Last Planner® System. The pilot projects yielded good results with lead time gains of around 15%. The company's staff and supply chain willingly adopted collaborative planning techniques as all involved could see the benefit.

After the pilot projects the company's approach to production control using elements of the Last Planner® System was standardised and applied on every live project.

Following this initial stage, they wanted to go further to fully embed the culture of lean but were unsure of the best approach. A number of options were investigated including pursuit of the new ISO18404:2015 international standard for lean and six sigma and this route was agreed.

Implementation of ISO 18404

No company had done this before, and the path was unclear, also, accreditation to the new lean standard might provide a useful path for wider industry to follow. Therefore, they

approached the Construction Industry Training Board (CITB) for help. An application was made to CITB's Flexible Fund which was successful and then CITB staff worked with Gilbert & Goode to help put measurable deliverables in place and also to ensure the project would benefit wider industry. A plan for the deployment project was formed and work started in earnest in December 2017.

Key project stakeholders included Gilbert and Goode, Acorn Blue, The Cornish CITB Training Group, Constructing Excellence, The Royal Statistical Society (RSS) and The British Standards Institute (BSI).

Gilbert and Goode were already certified to other management standards such as ISO 9001, 14001 and 18001. These cover quality systems, environmental and health and safety standards respectively. They wished to create a single integrated management system, based on lean principles using the new 18404 standard.

Certification to the ISO18404 requires a company to employ internal staff resources that meet the competences detailed in the standard and so key personnel received training. The MD, the Head of Development, the Head of Construction and a dedicated Project Manager to oversee initial implementation were trained to Lean Leader level. Eight other key staff covering project management, site management, sales and aftercare undertook Lean Practitioner training. In addition, three staff from Acorn Blue were trained to Lean Leader and Lean Practitioner levels.

External resources employed included: Prof T. Bendell who chaired the committee that authored the standard and could provide strategic guidance. Dr Steven Ward provided lean construction specific training and acted in the capacity of certified Lean Expert under the standard. Also, Robert Meldrum of Quality Aspects advised on ISO related issues and helped with the creation of the integrated management system manual.

A strategy was formed that clearly linked the lean improvement efforts back to the company's corporate strategy with metrics that could be tracked. This appears in Figure 1.



Figure 1. Lean Strategy Summary

During training a wide range of lean improvement projects were agreed covering the end to end value stream from design development and acquisition to sales and aftercare. These projects were prioritised on a single page plan and implemented according to capacity constraints, with some projects agreed but “queued”. The business case for each project was weighed against its likely ability to deliver against the headline KPIs in the strategy document.

A Lean Management team, made up of the company’s Lead Leaders, was created to oversee the delivery of the strategy. Five Lean improvement forums were established to support each of the KPIs and manage the improvement projects, each one being led by a Lean Practitioner and sponsored by a Lean Leader. This structure formed the basis of the company’s continuous improvement architecture and is shown in Figure 2.

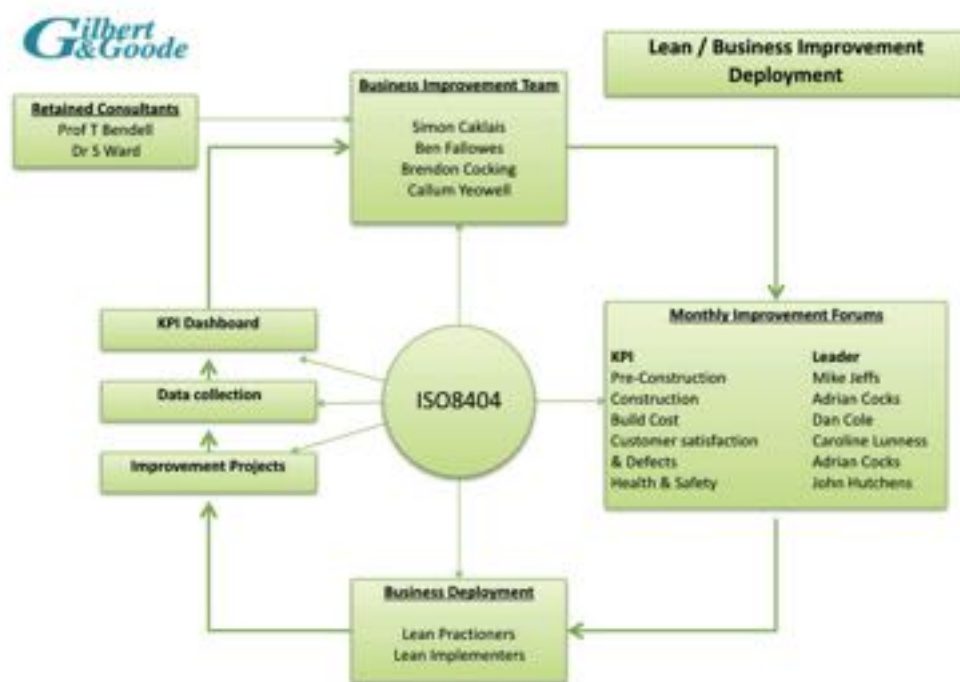


Figure 2. Architecture for Continuous Improvement

It was found that a further level of competence was required that did not exist in the standard. This level required fewer skills than Lean Practitioner, but measurable competence was sought so the competencies of Lean Practitioner were refined to a more basic level and “Lean Implementers” were trained. This served to widen the net in terms of who and how many people got directly involved in improvement efforts. A further 100 people in the business including key suppliers also received training at a basic level. During 2018, virtually all the company’s staff contributed to business improvements in some way.

Certification by The Royal Statistical Society and British Standards Institute

Throughout 2018 the company continued to execute the agreed plan. This was led directly by the senior leadership team with consultant support. Lean Practitioners and Lean Leaders were coached in the development of their portfolios of evidence required and were examined for competence by the Royal Statistical Society, the sector scheme owners, during

October 2018. The British Standards Institute was invited to audit against the ISO Standard and carried out stage one and two audits during December 2018. The registered scope of assessment was “The management and maintenance of Lean programmes when delivering construction services.”

On the 9th of January 2019 the company received certification to the new standard, the first company worldwide to achieve this.

In terms of transformation, it is not the case that every single action or process by Gilbert and Goode is guaranteed to be lean, or that they now perform better than any other company of their kind. Rather it is the case that the majority of people working in the business understand the key concept of value for the customer, are supportive to continuously improving this and have a realistic methodology for doing so.

Results for the pilot – the bottom line

“In addition to the training and upskilling of individuals and the marketable kudos of the certification of the business, Gilbert & Goode are realising value to both their bottom line and also that of their clients. The primary value add is on time saving across the design and delivery of schemes through improved collaborative planning techniques, thus reducing management & site preliminary costs and accelerating the income streams from the completed homes, whether for sale or rent. Based on projected future volumes, this could equate to a circa. 10% improvement on the bottom line.

Beyond the time related financial benefits, there has also been a number of one off savings, that have come from improvement projects which have been informed by the analysis of the data presented at the monthly improvement forums, such as changing components, increased levels of off-site production and utilising new technologies. There are also many qualitative improvements, often as a result of using simple visual management techniques, that make sites look more professional, which in turn will make them safer and more efficient, albeit, this may be hard to measure directly.

The process has also identified a challenge around getting accurate baseline data upon which to set targets and the data maturity journey that a business is likely to face, making accurate measurements of improvement, particularly at a macro level, difficult in the short to medium term.”

(Simon Caklais – Managing Director)

Results for Wider Industry

Proof of Concept – The first construction company to achieve ISO 18404 certification

Guidance on how to approach certification on the form of assessment tools, example ISO manuals and case study documents.

Training materials for Lean Leader and Practitioner Levels developed and available.

Published academic paper at the International Group for Lean Construction Conference (IGLC 2019) Dublin and dissemination via the Constructing Excellence Network in the UK.

2.

INTRODUCTION AND REASONS FOR THE PROJECT

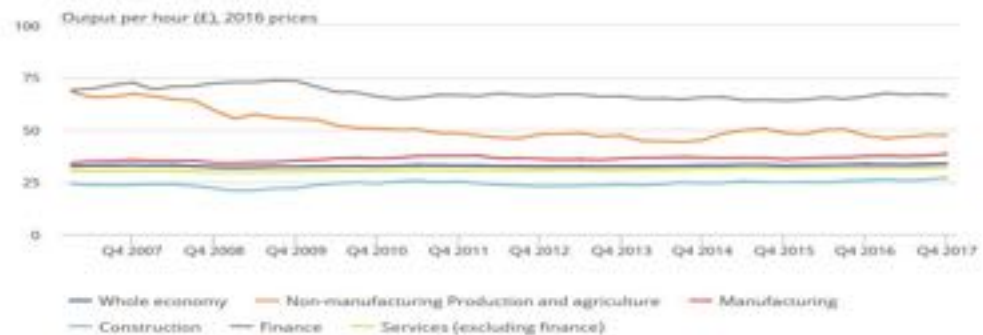
Need for Productivity Improvement

Globally the construction sector has not been able to keep pace with productivity improvements achieved in other sectors. A recent report (Barbosa et al 2017) highlights productivity growth in the UK has been flat since 1995 and lags the general economy.

The construction sector remains the least productive industry in the UK, at more than 20 percentage points below the average output per hour for the whole economy in 2017. In contrast, the manufacturing sector remains 10% above the whole economy average as shown in Figure 3 below. (ONS 2019)

Figure 10: Labour productivity – whole economy with sector breakdown, 2007 to 2017

Output per hour (£), seasonally adjusted, chained volume measure, UK



Source: Office for National Statistics – Labour productivity: Breakdown of contributions

Figure 3. Construction Productivity vs Other Sectors - Office for National Statistics (ONS 2019)

The Glenigan Construction KPI Report 2018 summarises UK construction performance: -

- Projects on Time (Construction) 59%
- Cost Predictability (Construction) 66%
- Defects at Handover (% scoring 8/10 or better) 82%
- Client Satisfaction value for money (% scoring 8/10 or better) 73%

Get it Right 2016

This UK report concludes that up to 21% of construction cost arises through errors and rework.

The Construction Skills Network Programme Report WLC & Experian (CITB 2015-2017) states: "There is an urgent need for better training in leadership and management for those occupying supervisory positions and above." Also, "CITB should enter into discussions with trade associations and training providers to explore the potential for creating a greater emphasis on productivity improvement in labour force training."

The local situation in Cornwall is even more challenging with Cornish productivity only reaching 71% of the UK average (ONS 2019)

Need for standardisation in training and approach to improvement

Since the Egan Report in 1998 there have been many attempts to apply lean thinking to the construction sector, and in isolation some of these have yielded encouraging results. Yet as a whole the sector has failed to grasp the nettle. There have been many successful ad hoc “interventions” but very few business or supply chain “transformations”

To date there has been no standard to benchmark or procure against, and no set of standard competencies that can adequately describe “LEAN” to train to.

According to Professor Tony Bendell who chaired the committee that authored ISO18404 Lean Standard: -

“Lean & Six Sigma are a growing process improvement, training and recognition market and many available certifications do not provide any real assurance/integrity. Couldn't be sure people applied Lean correctly, and many did it and trained it badly. Organisations implemented and managed Lean & Six Sigma badly.”

Also, CITB were aware of varying standards in Lean Training.

“Lean construction techniques – low productivity, low margins, lack of collaboration and continuous improvement can be addressed through standardising lean training approaches”

(Sandra Lilley & Steve Radley CITB Evidence Forum Presentation March 2017)

The aspiration for the deployment of ISO18404 in the Construction Sector was to provide a repeatable “roadmap” to enable lean transformation in the context of organisation wide deployment and creation of a lean culture throughout a construction business.

The philosophy, tools and techniques of lean construction are well known. (Ansah et al. 2016) For those that apply these, the benefits are also well known. However, the industry as a whole has not adopted lean thinking and has not kept pace with the rate of improvement that other sectors have enjoyed (Barbosa et al. 2017). The existing research on this subject is full of reasons, barriers, peculiarities of construction and excuses why this is so (Ballard & Howell 1998; Koskela 2000). Over the last twenty years many applications of lean construction have occurred, as evidenced by the significant body of literature on the subject. However, it would appear that the vast majority of attempts to apply lean in construction are of an ad hoc nature, mainly either on a project basis or maybe a narrowly focused process improvement basis. Ward (2015) based research around lean construction interventions because there were not enough available data on transformations in construction available.

Standardisation is a theme central to lean and can be seen throughout its history and development. (Graupp & Wrona 2006). The international organisation for standardisation is an independent, non-governmental international organisation with a membership of 163 national standards bodies. (ISO 2019a) In late 2015 a new management standard was published, ISO 18404:2015, that “*defines the competencies for the attainment of specific levels of competency with regards to Six Sigma, Lean, and “Lean & Six Sigma” in individuals,*

e.g. *Black Belt, Green Belt and Lean practitioners and their organizations.*” (ISO 2019b). The certification of individual’s competencies to an international standard may interest the lean construction community, but the opportunity to gain organisational accreditation to a lean international standard is of particular interest because it may possibly assist with overcoming some of the barriers to more widespread adoption of Lean Construction. The usefulness of ISO18404 in construction as a transformation model is therefore explored.

Review of Relevant Literature

ISO18404

A search using the term “ISO18404” returned nil results on the IGLC conference paper web page but a Google search using the term “ISO18404 Construction” returned a few relevant results, but all linked to the case study to be discussed here.

The question is whether this ISO standard can assist with construction company lean transformations; so, the term “transformation” was again used on the IGLC website. This time 79 papers were displayed. Two forms of transformation are discussed in these. The first is concerned with Koskela’s Transformation Flow Value theory (Koskela 2000) and about process, but the second is about culture change and the industry uptake of lean. For clarity the latter is the focus of this paper.

Of the 79 papers, fifteen appeared related to the subject of transformational change in the construction sector and of these a further two were discounted after closer examination. The remaining papers were mainly concerned with organisational structure, roadmaps for lean transformation with clarifications of lean concepts, leadership and change by force.

Organisational Structure

According to Arbulu and Zabelle (2006), temporary organisations associated with construction projects provide an advantage when seeking transformation which is contrary to the majority of literature on the subject of lean, that suggests temporary organisations are a barrier. Pekuri et al (2014) discuss the need to create appropriate business models for lean construction transformation to take place, they examine the business model employed by the exemplar Toyota and compare this with usual construction business models. In the lean driven example provided, it appears that there is a clear *link between lean operations, capability and strategy*. They conclude that an appropriate business model is necessary for successful transformation.

Roadmaps for lean and clarification of concepts

A common theme across several papers discusses the perceived need for a roadmap for lean construction transformations. Naney et al. (2012) provide a useful discussion on construction-sector-wide adoption of lean. They use the Hype cycle of innovation as a tool to gauge transformational success and also link the slow uptake of lean construction, to Moore’s “Crossing the Chasm,” technological adoption curve. (Moore 1991) This appears similar to change curve thinking (Kübler-Ross 1969). They point out that industry wide construction sector strategies for transformation are missing, and the key *“Early majority group in Moore’s change adoption curve need a “compelling case and/or a roadmap to follow.”* They conclude that for castor wide uptake of lean construction, we must learn how to bridge the gap between the *early adopters and the early majority*.

The further development and adoption of a lean construction maturity model is recommended by Nesensohn et al. (2014). They are not clear on why this is needed or

what benefit it might bring but Sainath et al. (2018) offer another maturity matrix for lean construction based on the perceived need to provide clarity to industry of lean concepts and also to gauge progress toward achieving these. Following Naney et al such a model might help provide the missing roadmap necessary to engage the “Early Majority” of the construction sector. Nesensohn et al. (2015) build on their earlier work concerning a maturity model and offer a more complete version, they reinforce the idea that a clearer definition of lean construction and a roadmap to follow will help transformation. Ward (2015) labours unsuccessfully over a definition of lean construction but also believes it would add significant value. Leonova et al. (2017) also call for the need for clarity regarding lean concepts, adoption and definitions.

Leadership

Lean construction in the context of organisational change caused by the adoption of the lean philosophy as opposed to the adoption of tools and techniques is discussed by Pekuri et al. (2012). They highlight 5 corner-stones necessary for success as *Leadership, Motivation, Competence, People and Trust*. Keiser (2012) is also focused on aspects of leadership, aiming to create “High Performance Teams.” (Katzenback and Smith 1993) The role of leadership in transformation is discussed by Kerem et al (2013) who show how *leadership training* in lean at the coal face had a positive impact on organisational change and provide practical help on the subject of what lean leadership should look like in construction. This links with Torp et al. (2018), who compare lean transformation attempts across several linked companies within the same holding group and provide a key observation that a top down approach from senior management was essential. More guidance on business transformation using a top down and bottom up method simultaneously is provided by Kalyan et al. (2018) This model has many similarities to the case study discussed in this paper below.

Change by force

Citing the first obstacle to lean construction as “*unwillingness to change until forced*,” Gehbauer et al. (2017) commendably propose transformation on a grand scale driven by focused collaborative research, They insist that culture change is the key as the ingrained behaviours of industry must change in order for lean to flourish.

An overview of the requirements of ISO18404

The ISO18404 Standard (BSI 2015) can be broadly divided into two parts.

Firstly, it provides guidance on the knowledge and competencies that a person delivering lean improvements in an organization should be able to display. In the standard’s appendices there are three detailed tables for differing levels of expertise named Lean Practitioner, Lean Leader and Lean Expert. The competencies include a wide range of lean skills and at Practitioner level are mainly concerned with application. At Leader level they include application, management and some training ability. At Expert level, application, management and training ability for all competencies is expected.

If an organisation has its own certified Lean Leaders or Lean Expert in place it is allowed to certify its own Lean Practitioners internally. A Lean Expert may also be an external resource if appended to the company’s management system.

The second and perhaps most important part of the standard in regard to transformation describes requirements for organisational certification. To achieve certification an organisation must be able to demonstrate that:

It has the required resources in place including an appropriate level of **competent** personnel, and that this competence is maintained. (competence as defined in the appendices described above)

A clear link can be displayed between the lean deployment and company **strategy** with defined objectives.

An appropriate **architecture** needs to be in place. For example, a reporting structure, steering groups, accountabilities and support.

It can display structured **continuous improvement** with defined metrics, targets and review mechanisms.

How the project began

Simon Caklais, MD of Gilbert & Goode, understood the benefits lean construction could bring, he had previously experienced these whilst working for BAA.

In 2016, via the Constructing Excellence network, he contacted Steven Ward of Lean Construct Ltd, initially to provide some training in Collaborative Planning Techniques.

Collaborative Planning is also known as “The Lastplanner System® of Production Control” and seeks to improve workflow reliability and therefore productivity as a result. (Ballard 2000).

A Pilot Project with a new build housing scheme that involved the full supply chain was used to test the concepts locally. This resulted in a 15% reduction in lead time, but also resulted in generating a good deal of enthusiasm from both Gilbert & Goode staff and their supply chain. A wider role out commenced but was largely limited to Collaborative Planning.

The senior Management at Gilbert & Goode now wished to fully embed lean thinking in its build process to include development, design, construction & sales.

Various options for training were discussed and it was decided to pursue the new ISO 18404 lean standard and if possible, develop an integrated management system that would include H&S, Quality & and environmental standards but with lean principles at the centre.

This had not been achieved by any company to date and the path was unclear. It was decided to approach CITB and apply to the Flexible Fund.

3.

AIMS & OBJECTIVES OF THE PROJECT

The prime objective was for Gilbert & Goode to achieve company certification to ISO 18404 by BSI.

The secondary aim was to be able to provide benefit to the wider industry as a result of the project by providing suitable guidance on how another company might go about implementing lean.

Further to discussions with CITB the following specific aims and objectives were agreed as part of the project.

3.1 HIGH LEVEL AIMS

Objectives	Key Learning
Best practice materials to be developed to enable employers to prepare and achieve ISO18404 accreditation	To give other employers the direction to be able to achieve ISO18404 accreditation using materials, templates and guides
11 candidates trained to required standards to achieve Lean accreditation; 8 accredited	To prove that the methodology is repeatable in its ability to develop organisational capacity to achieve ISO18404 accreditation
Two organisations taken to the point where they are able to achieve accreditation; one achieves accreditation	To show that the methodology can be used by another organisation and is repeatable in its ability to develop organisational capacity to achieve ISO18404 accreditation

3.2 DETAILED OBJECTIVES

Detailed objectives were agreed that included: -

- the development of Lean Leader and Practitioner Training Modules with the materials available as PDFs
- Eight staff to attend Lean Practitioner Training and six of these to achieve certification. (two from Acorn Blue)
- Three candidates to attend Lean Leader Training and two to achieve certification by The Royal Statistical Society. (One from Acorn Blue to attend)
- 100 completions in entry level lean training (20% to be external partner members)
- Six Level 3 Business Improvement Techniques Diplomas to also be taken by the Lean Practitioners
- An Employer best practice guide to organisation accreditation produced to include a redacted / anonymised procedures manual and a maturity Matrix for achieving BSI certification to ISO18404 with guidance notes
- One organisation to be awarded BSI certification to ISO18404 (Gilbert and Goode)

3.3 THE APPROACH TAKEN TO DELIVER THE PROJECT

3.3.1 THE TEAM INVOLVED AND ROLES & RESPONSIBILITIES

The success of the project relied heavily on the abilities of the delivery team involved.

Particular subject expertise would be a prerequisite. The following table provides explanation of who did what.

Name	Company	Role in the Project	Reason for Involvement & responsibilities	Steering Group or Beneficiary?
Dr Steven Ward	Lean Construct Ltd	Project Manager, planner, coach.	ISO18404 certified Lean Expert. Overall responsibility to manage achievement of deliverables agreed	Steering Group
Prof. Tony Bendell	Services Limited	Strategic guidance and Lean Leader Training. Lean Leader training materials	Prof. Bendell has unique knowledge of 18404	Steering Group
Robert Meldrum	Quality Aspects	Development of the Lean ISO manual and Integrated management system	Existing knowledge of G&G ISO systems. Best practice guidance development	Steering Group
Richard Herbert	Lean Construct Ltd	Trainer for Lean Practitioners & NVQ candidates	BIT NVQ assessor/ trainer/ approved centre manager	Steering Group
Stuart McKendrick	Royal Statistical Society	Sector Scheme owners	Run External invigilated examinations for ISO certified candidates	Steering Group
Shahm Barom	British Standards Institute	Awarding Certification Body	Provision of audit and certification	Steering Group

Simon Caklais	Gilbert & Goode	Lean Leader managing Director	Strategic direction, internal training	Beneficiary
Ben Fallowes	Gilbert & Goode	Lean Leader Development manager	Strategic direction, internal training	Beneficiary
Callum Yeowell	Gilbert & Goode	Lean Leader Project Manager	Development of KPIs and G&G Lean Practitioner progress	Beneficiary
Brendan Cocking	Gilbert & Goode	Lean Practitioner	Strategic direction, internal training	Beneficiary
Caroline Lunness	Gilbert & Goode	Lean Practitioner	Develop and deploy improvements	Beneficiary
Steve Luck	Gilbert & Goode	Lean Practitioner	Develop and deploy improvements	Beneficiary
Mike Pelan	Gilbert & Goode	Lean Practitioner	Develop and deploy improvements	Beneficiary
Craig Kendall	Gilbert & Goode	Lean Practitioner	Develop and deploy improvements	Beneficiary
Mike Jeffs	Gilbert & Goode	Lean Practitioner	Develop and deploy improvements	Beneficiary
Adrian Cocks	Gilbert & Goode	Lean Leader	Develop and deploy improvements	Beneficiary
David Stein	Gilbert & Goode	Lean Practitioner	Attend training and apply what is learnt to Acorn Blue	Beneficiary
Chris Trew	Acorn Blue	Lean Practitioner	Attend training and apply what is learnt to Acorn Blue	Beneficiary
Wayne Rundell	Acorn Blue	Lean Practitioner	Attend training and apply what is learnt to Acorn Blue	Beneficiary

3.4 ACTIVITIES DURING 2018

An initial collaborative planning meeting was held in late 2017 with the key stakeholders to form a plan of how the project would be delivered, timescales and roles and responsibilities. Whilst the CITB contract specified completion by the end of April 2019, the team were keen to accelerate and agreed to strive for the main achievement (certification by BSI) by the end of 2018.

This programme was used throughout the project to track deliverables.

We decided to begin with the development of the lean leader and lean practitioner modules which were then used to train the ISO 18404 candidates.

This would be necessary early in the project as a key requirement for certification to Lean Leader standard is that the Lean Leaders must themselves be able to evidence training capability in lean techniques.

The Lean Practitioner Module covers four days classroom training and maps exactly to the knowledge requirements of ISO18404, contextualised for the construction sector. The Lean Leader Module is similar but with a further two days. The requirements for Lean Practitioner competence under ISO18404 cover thirteen competencies that call for knowledge of the subject area, evidence of application in practice and some management of the competencies.

The requirements for Lean Leader competence under ISO18404 cover eighteen competencies that call for knowledge of the subject area, evidence of application in practice, evidence of management of the competencies and also evidence of training in some competencies. This training element is a key learning point for discussion later in this report.

The classroom courses only seek to cover the knowledge requirements of the standard. Further coaching was required and may be required by others in order to develop a portfolio of application evidence necessary for certification.

Whilst the training was underway significant effort was invested into the development of a suite of KPIs for Gilbert & Goode performance.

The ISO Standard can be considered at its simplest in two parts. Firstly, competence of personnel and secondly an effective lean system. In order to create this, meaningful KPIs are essential. Callum Yeowell began the project as a site manager and trained as a Lean Practitioner. However, it soon emerged that he would be better placed as a Lean Leader and during the course of the project he was promoted to Project Manager.

Callum took a key role in the development of the KPIs, working closely with Simon Caklais the Managing Director. The following summary document was produced which eloquently shows how the lean efforts are linked to business strategy with measurable outcomes. This is a pre-requisite for organisational achievement of ISO 18404.

“I believe the implementation was successful in changing the culture within the management and site teams however there is a bit of work to do cascading this down to the workforce. We are aware of this and will treat it as a lean objective.” --- Brendan Cocking
-- Head of Construction



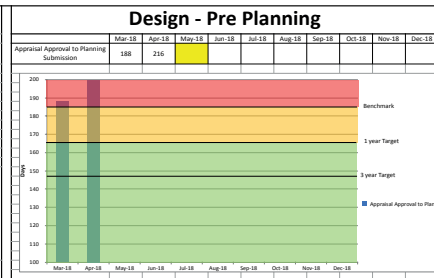
Figure 4. Lean Structure to fit ISO 18404

“A Lean culture has been substantially embedded within key personnel and within the lean forums. Somewhat lesser to wider staff. Lean thinking and improvement is becoming more consistent and will improve over time. We need to ensure new staff fully understand the methods and culture.” Ben Fallowes – Head of Development

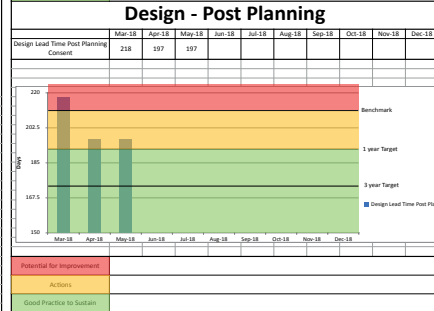
A further organisational necessity is to be able to judge the efficacy of the lean system against measurable objectives. A KPI dashboard was therefore created to track high level progress and is shown below.

Business KPI's

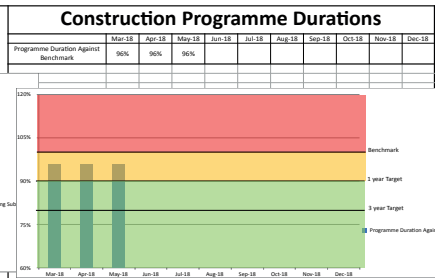
Working towards ISO18404



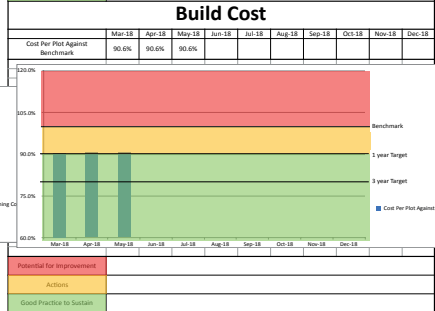
Potential for improvement
Actions
Good Practice to Sustain



Potential for improvement
Actions
Good Practice to Sustain



Potential for improvement
Actions
Good Practice to Sustain



Potential for improvement
Actions
Good Practice to Sustain



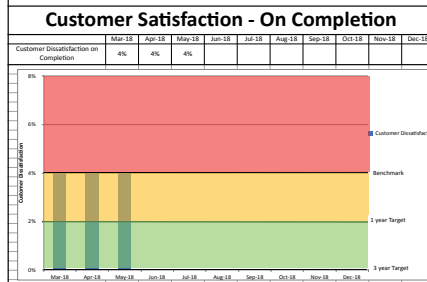
Commercial Team Lean Workshop



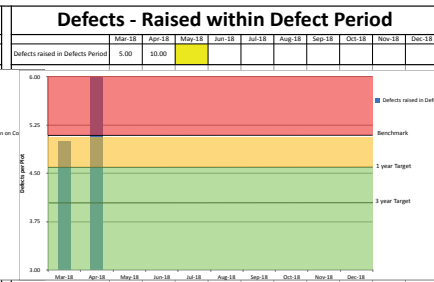
2nd Lean Touch Session & Skip Minimisation Workshop



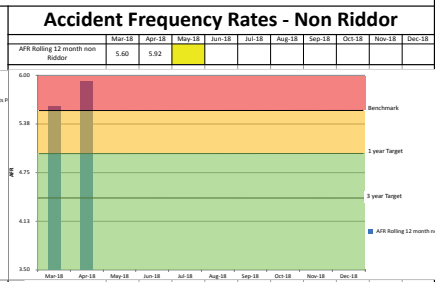
2nd Lean Implementer Session



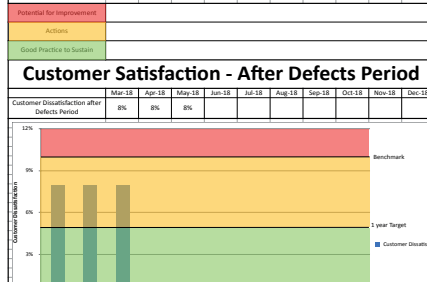
Potential for improvement
Actions
Good Practice to Sustain



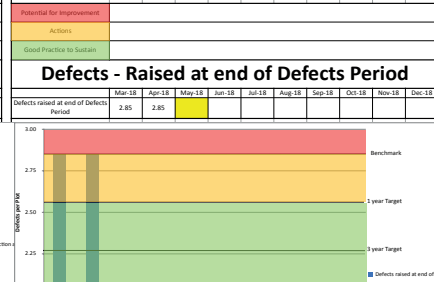
Potential for improvement
Actions
Good Practice to Sustain



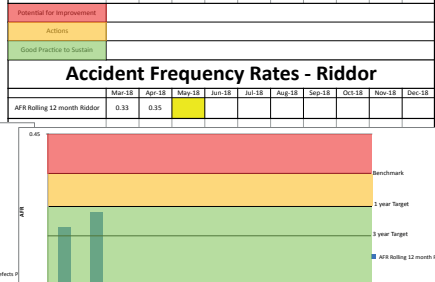
Potential for improvement
Actions
Good Practice to Sustain



Potential for improvement
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Good Practice to Sustain



Potential for improvement
Actions
Good Practice to Sustain



Potential for improvement
Actions
Good Practice to Sustain

Owner: Callum Yeowell Updated: 5/18/18 Next Update: June

Figure 5. The KPI Dashboard

3.4.1 LEAN BASICS TRAINING

Widespread involvement was achieved by the Lean Leaders carrying out basic lean training in Gilbert & Goode and their supply chain themselves. Over 100 construction personnel received training over a period of about nine months. It emerged early on that there was a gap in the ISO 18404 competency requirements and that a level below Lean Practitioner was also needed. As part of the Lean system it was decided to define the knowledge and competencies of “Lean Implementer” to fill this gap.



Figure 6 Training activities

The Lean Basics Training consisted of half day sessions led by one of the Lean Leaders with consultant support. These were called “Lean Touch” sessions and covered the benefits and history of lean, the reason why Gilbert and Goode were doing it and then focused on a basic understanding of value and waste within a lean context. This was followed by a practical improvement session where delegates were asked to identify process waste in their own area of responsibility and form an action plan to improve this. These sessions were held in formal training/conference facilities at the St Austell Business Park Conference Centre. It was obvious that some of the basic training attendees were enthused to get involved and do more. These were offered “Lean Implementer Training” This was not a planned deliverable of the project but emerged as a need. The Implementer training was mainly led internally by the Lean Practitioners.

Of the 100 people trained to a basic level 62 were employed by Gilbert & Goode and 38 were from external local companies. 80 were male and 20 female. Thirty-Five delegates held jobs at middle to senior level and included directors, design managers, architects and surveyors. 28 delegates were either tradesmen or support staff. The remaining 37 delegates worked at first line supervision level and were both site and office based.

3.4.2 IMPROVEMENT FORUMS

Once the Lean Practitioners were trained improvement forums were set up with champions for each KPI as shown in Figure 2 on page 5. This was key in the development of a necessary lean infrastructure required by ISO18404. These forums continue to meet monthly to review the progress of improvement projects and to assess the effects linked to the overall improvement strategy. To help facilitate this a tracking spreadsheet was produced that shows the list of current and planned improvements projects, who is involved, and the expected impact against the headline KPIs. Each improvement project was assigned an estimate of the percent it could contribute to the achievement of the overall KPI improvement targets. For example, in the sheet below “DES 2 Designer Monthly Planner” if implemented was expected to deliver 5% of the required 10% pre-start KPI improvement.

This is shown below.

PROGRESS TO DATE

LEGEND				KPIs												
Status No.				Pre-Construction	Construction	H&S A/R	Build Cost	Customer Satisfaction (On Completion)	Customer Satisfaction (After Defects Period)	Defects	Reduce Failure Demand/ Free up Time	Progress	Remaining			
Allocated	1															
Started	2															
Reviewed	3															
Complete	4															
Strong Impact	P		P													
Partial Impact	t		t													
Project ref.	Description	Lean Champion														
Des1	Design Last Planner (Tracker)	Mike Jeffs		0%								100%	0%			
Des2	Designer Monthly Planner	Mike Jeffs		5%								0%	100%			
Cons1	Weekly Work Planning & PPC	Callum Yeowell			5%		2%					80%	20%			
Cons2	Timber Frame Option Trials	Callum Yeowell			0%		0%					100%	0%			
Cons3	Groundworks Procedure Restructure	Adrian Cocks			1%	1%	1%					0%	100%			
Cons4	On Time Material Procurement	Adrian Cocks & Callum Yeowell			0.5%							0%	100%			
Cons5	Reducing Kitchen Lead Times	Adrian Cocks & Callum Yeowell			0.5%		0.2%					0%	100%			
Cons6	8 Weekly Lookaheads	Callum Yeowell			2%		1%					20%	80%			
Cons7	Jetfloor (New Floor System)	Adrian Cocks & Steve Luck			1%		0.2%					5%	95%			
Cost1	New QS Required Info Forms	Shaun Rabey									◆	25%	75%			
Cost2	Reduced no. of Skips	Steve Luck					0.2%					10%	90%			
Cost3	Estimating Make Ready Needs	Darren Hicks									◆	50%	50%			
Cost4	Process Map of Key QS Functions	Shaun Rabey									□	0%	100%			
Cost5	Estimating Enquiries Standardised	Darren Hicks									◆	50%	50%			
Cost6	General QS Failure Demand Assessment	Dan Cole									□	10%	90%			
Dfct1	New QA System	Adrian Cocks & Callum Yeowell					0.4%					90%	10%			
H&S1	New Accident & Near Miss Reporting Documents	Callum Yeowell					0%				◆	100%	0%			
H&S2	Standardised H&S Standards	Adrian Cocks					1%					25%	75%			
Total				5%	10%	2%	5%	0%	0%	5%						
Remaining Percentage for 1 Year Target				5%	0%	8%	0%	2%	3%	5%						

Figure 7. Single Page Plan Linking Improvement Projects to Strategy

An example improvement project

“We have created a Pre-construction tracker covering the vast majority of tasks required from acquiring land through concept designs to a complete technical package ready for construction. This tracker is both a process to follow and an information directory. It allows the collation of all-important information points avoiding the need to clarify things repeatedly and ensures elements aren't lost throughout the process as months can pass between core stages. The document also includes guidance notes, points to check and target dates which can be reviewed collaboratively as a project team. Following our lean learnings this document has been altered following every issue raised or item missed, improving the process to reduce the number of issues & delays on future schemes. This will contribute to time, cost, quality & H&S of schemes going forwards.

On schemes we regularly have to obtain adoption of the highways and foul drainage onsite, this is undertaken through a process where designs are submitted to the relevant authorities for approval. For our schemes it is most common that there are 3 to 4 rounds of requests/queries from the relevant authorities of changes or clarifications they require in order to move closer to technical approval. Whilst some of these items are not foreseeable due to changes of requirements or complex inter-dependencies on legal rights or other authorities' requirements there are several comments that occur on every scheme which are simple and could be avoided. These simpler comments are now being collated on a document and circulated to engineers at two stages, once before planning submission and once before technical drawing submission. There are two strings of improvements here, the review before planning highlights required changes ahead of planning submission which makes the technical post planning period easier by removing the need for amendments to the planning for any design changes required, which removes both time and cost. The second review ahead of the technical submission is intended to lower the number of comments. These comments typically come in rounds which take 4-6 weeks to deal with, should a round of comments be able to be removed on any scheme this time period would allow the technical approval to be obtained earlier, consequently allowing construction to start or if already started removes the risk of changes earlier, saving costs and time if construction is not to commence until technical approval is obtained.

Project handover reports are now created when passing a scheme from technical through to construction following our learnings on the next customer approach. Typically, schemes were either not handed over in any routine process at all or were informal meetings with no structure or prepared documents. The reports now summarise key information and any outstanding elements, the effect of the reports are strengthened by the tracker due to collecting information throughout the project ensuring things are not forgotten or missed. This also allows for projects to be reviewed & discussed by all involved together in order to answer any final queries ahead of starting and agreeing the responsibilities of any outstanding tasks.

Currently each individual scheme is undertaken as a separate contract with each consultant, this requires each individual scheme to have a collateral warranty put in place. This requires both parties' insurers to review and agree on comments which is a timely process, this often delays the formality of the contract being signed not completed until the designs are already well underway leaving ourselves exposed should issues occur ahead of the contracts being signed. Additionally, time is wasted by both parties each time agreeing on the wording of individual clauses. Moving forwards, we are intending on creating a consultant framework over a term period, such as 3 years, by where the collateral warranty for the period would be agreed, removing the need to agree one per

scheme. In addition to the above this framework would bring/assist with other planned initiatives such as consultant KPI performance being monitored and resource levelling being reviewed to avoid over allocating work to any individual consultant which is a common occurrence at present. This would assist with project costs through staff time and timescales through better commitment to projects from consultants due to reducing our contribution to overstretching them on our schemes.

Previous efforts of continuous improvements within designs have consisted of verbal discussions between construction and pre-construction which are not always analysed in enough depth to follow through to the root cause. We are maximising the effectiveness of this continuous learning through formally recording it on a lessons learnt template which is to be followed through in conjunction with construction to ensure a root cause is determined, these are then captured in a summary list to provide to designers and use as a checklist to avoid these issues in future. The sheets will also address which factor will be improved; cost, H&S, time, waterproofing etc." Callum Yeowell - Lean Leader

Whilst continuing to work on practical Improvements, work on the ISO manuals was progressed initially under the direction of Robert Meldrum from Quality Aspects, with the final versions completed in house by Ben Fallowes and Callum Yeowell.

We wanted to produce an integrated management system to link ISOs 9001, 1400, 4500 and 18404. This was created but for clarity and also for the benefit of wider industry, a stand-alone lean manual was created.

Toward the end of the project internal auditor training was carried out with Gilbert & Goode senior team to foster ownership of the new system.

Gilbert & Goode now takes full ownership of its ISO systems and updates and manages them. External consultants are used but minimally.

A redacted and anonymised version of the lean manual is included as an output of the project and is available on the CITB website.

During 2018 Gilbert and Goode's management & staff worked on a wide range of business improvements and these served to generate the evidence that would be required by the sector scheme owners, The Royal Statistical Society (RSS) when they carried out the Lean Leader examinations and also for the British Standards Institute (BSI) when auditing the company against the standard.

Ongoing Coaching was provided by Dr Ward who has both extensive Lean and construction sector experience. Many of the competence criteria in the in the lean standard are generic and need some sector contextualisation. Dr Ward helped guide the development of the Lean Leader Portfolios in preparation for examination by RSS.

In Late 2018 Lean Practitioner and Lean Leader examinations were held and certification for individuals achieved. During October and November of 2018 BSI conducted their audits.

3.5 ACORN BLUE

To help prove the concept in wider industry, CITB required that a second organisation got involved in the project and were taken to the point where they would be able to pursue achievement of ISO18404.

Acorn is an independent development and regeneration specialist that has, for many years, successfully created a range of residential-led refurbishment and new build schemes.

In recent years in Cornwall it has also begun to undertake main contractor responsibilities for its own developments.

David Stein, pre-construction director for Acorn Blue is also on the board of Constructing Excellence in Cornwall and currently deputy chair. So it was a natural step for David to get involved with the project. Three key staff members from Acorn attended training courses to Lean Leader and Lean Practitioner levels.

They conducted a wholesale review of their organisation and productivity issues applying lean principles. A key part of the process was mapping out with all staff involved the flow of activities from Initial Concept to a signed off Construction Design. Part of the map produced is shown below.

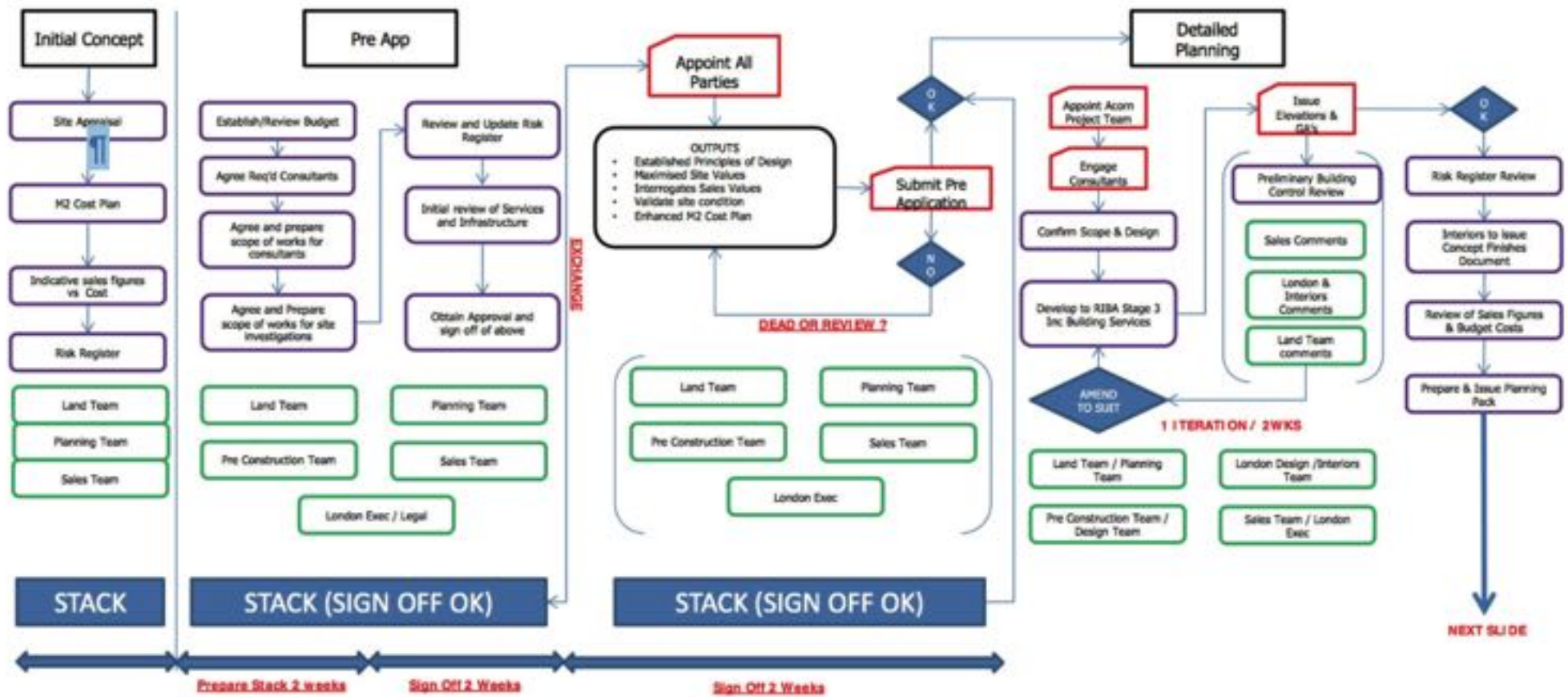


Figure 8 Acorn Blue Value Stream map Future State

Several issues were identified from the process, but it was difficult to gain any traction for change. This led to renewed efforts to quantify the losses being experienced and form a stronger business case. Over time the Cornish effort has encouraged the organisation at a national level getting much more serious about its processes and they have now appointed a dedicated resource to manage business improvement. According to David, *“The whole process of identifying and mapping existing methodology, testing validity and then eliminating repetitive or redundant elements has been massively aided through our involvement with the Lean Build workshops attended by a number of our team here in Cornwall. Although the wider business is probably not yet ready to embrace a complete adoption of Lean Build principles, it has already led to a more active approach to interrogating how we manage work streams.*

On behalf of Acorn, please accept my sincere thanks for your direction and practical help and I hope that as the business continues to refine and map its processes we will continue to gain from this experience.”

The work with Acorn Blue was at a local level in St Austell. During the project it was not possible to greatly influence the main office in London. For this reason, currently Acorn are not committed to adoption of the standard. However, the CITB project is likely to bring benefits that can only be fully assessed over several years as the work of the Lean Leader delegates at St Austell starts to influence the wider business.

4.

THE RESULTS OF THE PROJECT

4.1 PROGRAMME DURATION

The planned duration for this project was eighteen months and it was due to complete by the end of April 2019. All outputs apart from this report successfully completed by December 2018 and the last milestone evidence was submitted on the 31st January 2019, some three months early. It was decided to wait until the official end of the project to submit the final report so that more time could be utilised to fully reflect on the project, its outcomes and to gather more up to date data on achievements.

4.2 COST

CITB approved a grant of £151,208.00 including VAT to help fund the project, with a match contribution of £84,600 made up mainly of in-kind costs.

The project delivered all planned output within this budget. It is very likely that the in-kind costs exceeded those forecasts, but records were only kept up to the level in the plan of £84k.

4.3 OUTPUTS

All the deliverables stated in the CITB contract (explained in 3.2 above) were either met or exceeded. Those that exceeded the planned outputs included.

Four Lean Leaders Certified – not two as planned

Eight Lean Practitioners Certified – not six as planned

Lean Implementer standard defined – not in plan

The cost savings identified and reported in section 1.

The industry guidance outputs can be found on the CITB website.

5.

REVIEW & DISCUSSION

There can be no doubt that to be the first company in the world from any sector to achieve an ISO in Lean is an outstanding achievement. Overall the project has delivered early, within budget and exceeded the planned outputs.

It remains therefore to discuss the viability / appropriateness of the ISO for the construction sector and to think about next steps.

5.1 LESSONS LEARNED

In terms of the approach to the delivery of the project, if we could go back and start again one of the suggested changes would be to focus on getting the actual improvement projects going earlier rather than so much time on building lean capability and systems. On reflection this is really a chicken and egg situation. Capability needs to be built by gaining knowledge and experience of the subject. Otherwise it would likely fail in the long term. Building the ISO 18404 system is analogous to building a sausage machine with the sausages being quantifiable process improvements or problems solved. Not many improvements will emerge until the machine is properly built and running. What we were really achieving is creation of the ability for a construction business to continuously improve in the long term.

The following learning points were derived by a combination of direct observation of the Lean Leaders, participation by the company's staff and by content analysis of interviews conducted with the Lean Practitioners after the implementation completed.

It was observed that initial motivation for the transformation appeared both internal and external. Internal derived from leadership vision and external from market conditions.

Management led from the front. The ISO18404 standard at Lean Leader level requires the leader to be able to train certain lean skills. The senior management team all took part in personally training their own staff. According to the Managing Director – this was key to getting buy-in and signalling that a new, continuous improvement culture was operating.

All staff were involved at some level and were in no doubt as to the purpose of the efforts, again supporting buy-in of the continuous improvement culture.

A clear link was created between overall strategy and lean deployment activity.

A clear path was available in terms of the guidance in the ISO 18404 standard, with the architecture and resources put in place to deliver and sustain the lean management system.

There was consensus that a tangible shift in overall culture had been achieved as a result of the implementation.

Difficulties with data capture and the ongoing management of this were a concern.

The sequence of training could have been improved with Lean Leaders beginning before Lean Practitioners and then cascading.

There was consensus that ISO18404 could help the construction sector but that each implementation must be tailored to individual organisational needs.

Practical aspects like weekly planning deployment and waste walks were seen as a significant contributor to success.

Dedicated resources for data capture & management and also helping continued administration of the system are required.

Implementation would have been extremely difficult without the external consultant expertise

5.1.1 THE IMPORTANCE OF DATA

As the standard title suggests “quantitative methods in process improvement”, data collection and analysis are vital in supporting continuous improvement in a business. Target improvements to Key Performance Indicators (KPIs) are typically based on historic performance of the business, however the accuracy, type and format of the historic data may prove to be inadequate, especially as the focus on data capture increases within a business; meaning performance may not appear to improve on certain measures, as the data quality improves. One example in this case study was the post-handover defects reduction KPI, which appeared to get worse in the short term, as the level of detail captured increased. In addition, a number of the quality improvement projects linked to a new visual based Quality Assurance system, would take over a year to go through the project lifecycle before the improvements could be properly calculated. This also then led to a review of KPIs both based on the frequency of new data sets and also the relevance of the measures to potential changing business objectives. For example, the original time target was overall reduction in project programme time. However, as the business moved to more sales rate ‘pull’ delivery, the metrics for batch or cycle time had a greater relevance. In summary, the learning here is that KPIs may need to be changed or rebased as the maturity of your data increases and your understanding and application of their use evolves but the fact that measurement has become a key component of the business’s continuous improvement culture, is the most important outcome.

5.1.2 LINKS WITH LITERATURE

In the literature review several key themes emerged and it is offered here that the case study may possibly help with the following areas.

1. The management system offers a “roadmap to follow” as recommended by Naney et al. as necessary to bridge the gap between the *early adopters and the early majority* on Moore’s adoption curve.
2. Pekuri et al.’s five corner stones of Leadership, Motivation, Competence, People and Trust can be observed.
3. Pekuri et al.’s links between capability and strategy and lean operations can be observed.
4. Leadership training following Kerem et al. was evident.
5. It could be viewed that the standard provides an operational definition of lean required by Nesensohn et al. and Ward.
6. Many of Ward’s “*Critical Success Factors for Lean Construction Intervention*” (2015) are observed to have been present: e.g. Management capability, buy-in, appropriate data, collaboration with sub/c, etc.
7. Improvement activity was top down, and bottom up simultaneously as recommended by Kalyan et al.
8. Gehbauer et al. (2017) states that the industry will not change until forced. As an ISO Management system there exists a clear capability to incorporate into procurement, thus potentially accelerating the uptake of lean principles by force. The effectiveness of business improvement using other related ISO systems was explored at length by Manders (2015) who found the best performers were internally not externally motivated as a key success factor. This does not concur with the “change by force” approach discussed by Gehbauer et al. Possibly the right answer is that both internal *and* external motivators are required.
9. Eight of Gehbauer et al.’s thirty-four questions are listed above, and it is thought that the adoption of an international lean standard could help answer these in a positive way.

5.1.3 CONCLUSIONS DRAWN FROM THE RESEARCH AND CASE STUDY

- In 2018, the first company in the world achieved accreditation to the new international lean standard ISO18404. This company is a Main Contractor based in South West England. This suggests that the standard is applicable and appropriate in construction.
- Following the literature review and case study, it is offered that this new standard could possibly provide the recommended roadmap identified in the research for others to follow.
- The ISO18404 standard is not perfect, but in time will be reviewed and improved. This is in line with any informed approach to standardisation. There are many other certifications and competency systems and it is likely that the 18404 standard will suffer from “not invented here” syndrome. However, it is the only standard currently available in lean that is truly global with an appropriate supportive infrastructure and has the possibility of embedment in procurement systems.

6.

PRODUCTS DEVELOPED

The following products were developed as part of the project and are in line with the required deliverables listed in 3.2.

1. Lean Practitioner Training materials
2. Lean Leader Training materials
3. Redacted Lean Manual (Strategy document)
4. Maturity matrix for readiness for 18404 and Best Practice Guidance
5. Case Studies

7.

PROFILE OF LEARNER ACHIEVEMENTS

Overall 113 people received training as a result of the project. 100 received lean basics training and 13 were trained to Lean Leader or Practitioners levels. Of the 13 that received more in depth training 10 went on to achieve certification. Of the 100 people trained to a basic level 62 were employed by Gilbert & Goode and 38 were from external local companies. 80 were male and 20 female. Thirty-Five delegates held jobs at middle to senior level and included directors, design managers, architects and surveyors. 28 delegates were either tradesmen or support staff. The remaining 37 delegates worked at first line supervision level and were both site and office based.

Those that went on to receive accreditation and/or qualifications are listed below.

Name	Company	Qualification/certification achieved
Simon Caklais	Gilbert & Goode	RSS 18404 Lean Leader
Ben Fallowes	Gilbert & Goode	RSS 18404 Lean Leader
Callum Yeowell	Gilbert & Goode	RSS 18404 Lean Leader and L3 NVQ in Business Improvement Techniques
Brendan Cocking	Gilbert & Goode	RSS 18404 Lean Leader
Caroline Lunness	Gilbert & Goode	RSS 18404 Lean Practitioner and L3 NVQ in Business Improvement Techniques
Steve Luck	Gilbert & Goode	RSS 18404 Lean Practitioner and L3 NVQ in Business Improvement Techniques
Mike Pelan	Gilbert & Goode	RSS 18404 Lean Practitioner and L3 NVQ in Business Improvement Techniques

Craig Kendall	Gilbert & Goode	RSS 18404 Lean Practitioner and L3 NVQ in Business Improvement Techniques
Mike Jeffs	Gilbert & Goode	RSS 18404 Lean Practitioner and L3 NVQ in Business Improvement Techniques
Adrian Cocks	Gilbert & Goode	RSS 18404 Lean Practitioner and L3 NVQ in Business Improvement Techniques

8.

RECOMMENDATIONS

As a result of this CITB project, the viability of ISO18404 as a business transformation model based on lean that can be standardised has been tested in the construction sector. It is a limitation of this research that so far only one construction company has accomplished this. More are needed to fully verify the potential for this standard. If so verified, it could provide a significant lever for change and help the industry “cross the chasm” between the “early adopters” and the “early majority” of the innovation cycle. If this were true, then it could help the construction sector accelerate its improvement efforts and close the productivity gap with other sectors.

Therefore, the next logical step is to expand the scope of the initial project to; -

- Run the project with a supply chain (ideally public sector) and not just one company
- form a new or modified form of procurement with this supply chain and client based on ISO 18404 as a new outcome.

This would benefit the sector by: -

- Providing construction clients with assurance that they are employing world class companies
- Provide external motivation to the sector to truly grasp the nettle of continuous improvement and catch up with other sectors.

9.

ACKNOWLEDGEMENTS

Thanks go to CITB and particularly Rachel Iredale and Nathaniel Cooke.

The Lean Leaders at Gilbert and Goode

- Simon Caklais, Ben Fallowes, Brendan Cocking and Callum Yeowell

The Lean Practitioners at Gilbert and Goode

- Adrian Cocks, Caroline Lunness, Craig Kendall, Mike Jeffs, Mike Pelan and Steve Luck

Our External Consultants

- Dr Steven Ward of WSP
- Prof Tony Bendell of Services Ltd
- Mr Robert Meldrum of Quality Aspects

10.

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**Piloting the Deployment of ISO18404
in the Construction Sector**

PROJECT REPORT

