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# Advancing the Implementation of Lean within Highways England's Small and Medium Sized Enterprises (SMEs)

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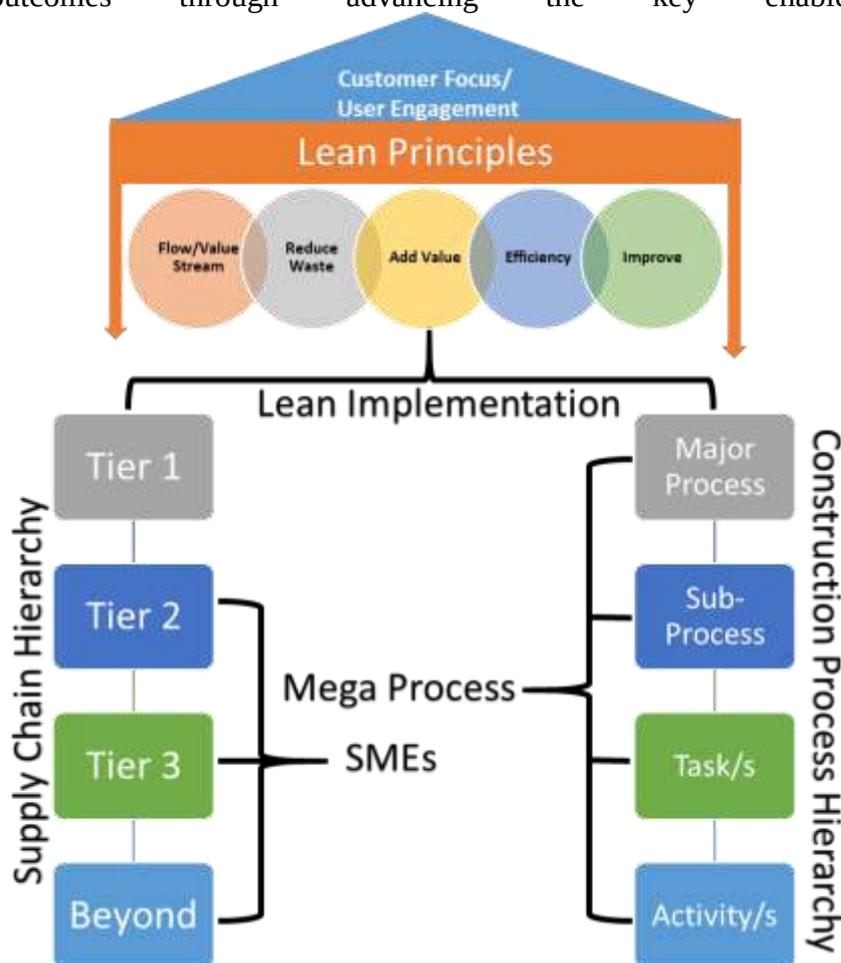
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# Executive Summary

This report introduces new set of key recommendations to promote collaborative working and engagement of SMEs to implement Lean within Highways England Supply Chain. These recommendations apply to the five strategic outcomes as set out in Highways England Delivery Plan 2015- 2020.

Highways England has identified four key enablers that will drive abovementioned five strategic outcomes. Lean implementation within Highways Supply Chain could play a key role to drive the strategic outcomes through advancing the key enablers.



INFOGRAPHIC 1: LEAN IMPLEMENTATION TO DELIVER HIGHWAYS ENGLAND STRATEGIC OUTCOMES

Implementing Lean in Highways Supply Chain is new. Lean focuses on delivering customer need and increase process efficiency by reducing wasteful activities while retaining quality and enhancing value. Implementing Lean in Highways Supply Chain would help to deliver better road network for less money. It is recognised that implementing Lean in Highways England Supply Chain has significant benefits for all stakeholders in terms of improving engagement, customer satisfaction, cost saving and delivery of quality.

This report draws upon relevant literature and interviews with 20 professionals working on the frontlines and emphasises on the issues that hinder the SMEs engagement and contribution to Lean

## Highways England Strategic Outcomes 2015-2020

- 1) Supporting Economic Growth
- 2) A Safe and Serviceable Network
- 3) A More Free-flowing Network
- 4) Improved Environment
- 5) An Accessible and Integrated Network

## Key Enablers

- 1) Collaborative Relationships
- 2) Driving Performance and Efficiency
- 3) People and Company
- 4) Managing Risks and Uncertainty

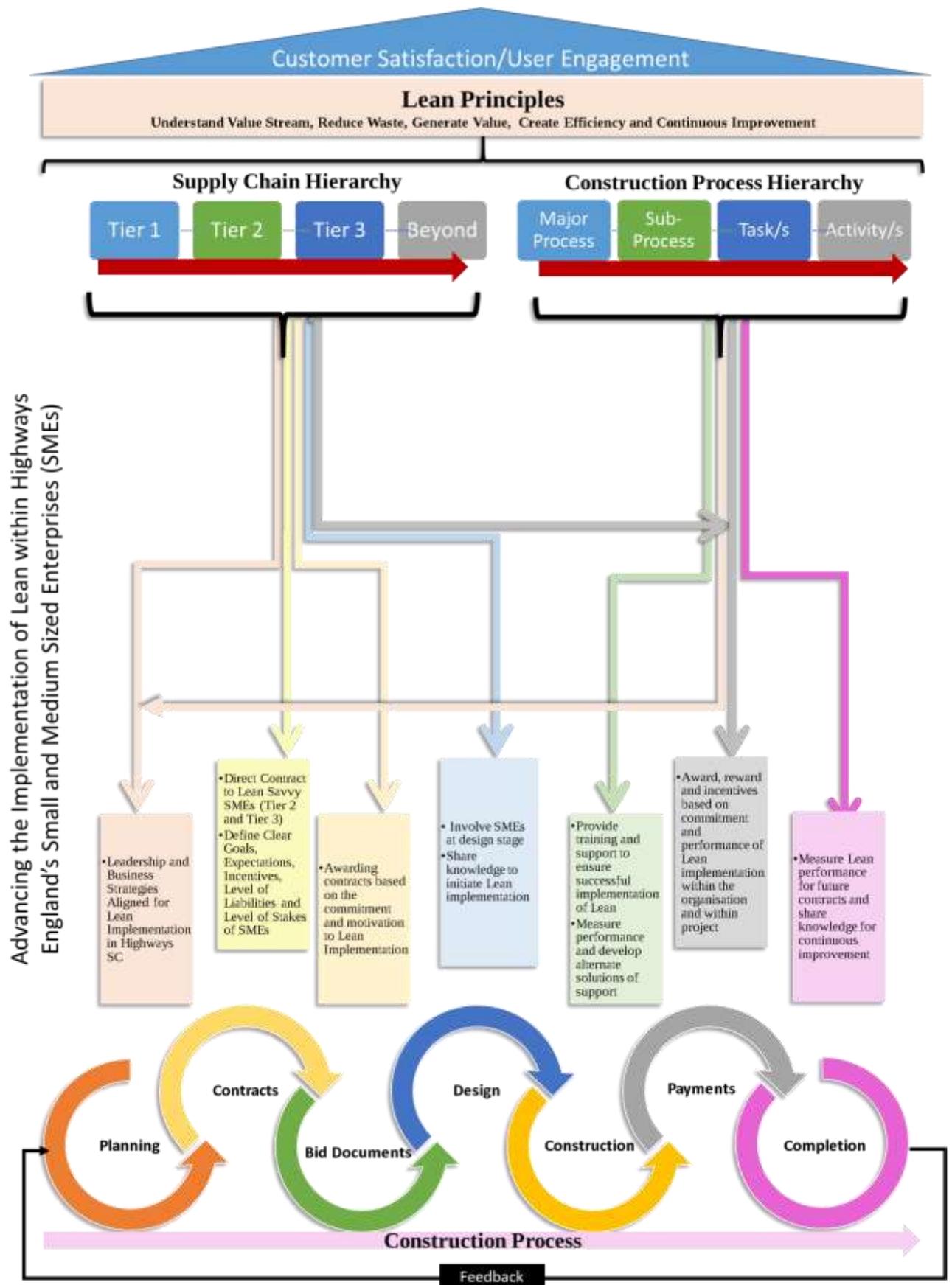
implementation within Highways Supply Chain. Below Infographic 2: Survey Respondents' presents the distribution of respondents and operational areas. The choice of respondents covers the entire Supply Chain of Highways England. This includes, four interviews of clients - Highways England, five interviews from Tier 1 - Large Contractors, four interviews from Tier 2 - Large Contractors and seven interviews from Tier 2 – SMEs.



INFOGRAPHIC 2: SURVEY RESPONDENTS

This investigation leads to key recommendations to advance SMEs engagement. The report suggests that implementing Lean within Highways England Supply Chain requires an equal effort at different levels (Organisational and Process) of Supply Chain. This report gives eleven key recommendations that would ensure smooth flow of Lean implementation at all levels of Highways England Supply

Chain. Key report recommendations are summarised in Infographic 33 below. All aspects of this infographic are discussed further in literature review and recommendations sections.



INFOGRAPHIC 3: ADVANCING THE IMPLEMENTATION OF LEAN IN HIGHWAYS ENGLAND



The overall experience of this study gave the research team confidence through the data collected that below valid inferences are required for further investigation.

- ☑ What is the best practice to involve SMEs in Lean Implementation?
- ☑ How to gain Lean commitment for Lean Implementation?
- ☑ What could be the best motivational approach for SMEs for implementing Lean?
- ☑ How Lean training should be delivered that advances SMEs knowledge and understanding of importance of Lean and its implementation in Highways England Supply Chain?
- ☑ How Lean performance measurement tools and techniques can be developed that assure a successful lean maturity?
- ☑ Knowledge sharing approach for successful implementation of Lean in Highways England Supply Chain
- ☑ What development in Highways England procurement process is needed

# 1 INTRODUCTION

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*“Highways England must demonstrate that it is supporting meeting the (expected) government target of 25% of direct and indirect spend to small and medium sized enterprises (SME)”*

*(Highways England Operational Metrics Manual, 2015)*

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Launched in April 2015, Highways England, formerly the Highways Agency, has long-term funding to improve, maintain and operate a roads and motorways of England. In the first five years alone, it will invest £11 billion in roads and motorways to tackle congestion improve safety and boost capacity. Working closely with the Department for Transport and with a long-term investment of £11 billion of capital spending, its key challenge is to maintain, operate and improve over 4000 miles of Strategic Road Network. SMEs are key enabler for realising Highways England Business Plan 2015-20.

To facilitate SME involvement in public procurement, Highways England must demonstrate that it supports the expected Government target of 25% direct and indirect spend to SMEs. With increasing amount of capital expenditure during 2015-20 period and target of £1.2 billion cost savings during this period, new operation models are being planned such as a move away from Asset Support Contracts in certain regions and Highways England managing the work itself. This opens up new opportunities for a deeper engagement with SMEs.

This report presents results of a research project focused on supporting Highways England with Lean implementation in the SMEs within its Supply Chain. Report authors’ visited/interviewed 20 Highways England SMEs to develop a better understanding of potential barriers/drivers associated with effective implementation of Lean Construction in Highways England’s Supply Chain.

This study adopts a systematic research methodology (see figure 1) that consist of exploring both explicit and tacit knowledge domains. Firstly, it investigates the explicit knowledge to define the current Lean implementation practice and scope of Lean in Highways Supply Chain through literature review, and pinpoints five Lean principles, defined by Highways England (see table 1). Furthermore, an in-depth literature review is conducted to develop a better interpretation of Lean implementation within Highways England Supply Chain. Moreover, the characteristics of five Lean principles are mapped to understand its application within Highways Supply Chain. Based on the characteristics of Lean principles and literature review, the relationships between the Lean principles is established (see table 2) to understand its implementation from Highways perspective, to deliver the aforementioned key enablers and strategic outcomes set out for 2015-2020.

This report draws key recommendations of advancing Lean implementation within Highways England SMEs from literature review and expert interviews. The 20 interviews conducted, four interviews were from senior managers within Highway England, to understand client perspective. These senior managers have been directly engaged with Lean implementation within SMEs. Each interview lasted about an hour. The data is interpreted to generalise the views of respondents about the Lean implementation in Highways England Supply Chain. The profile of those interviewed as part of this research is presented in table 1. It presents interviewee’s position, job description and main operational area. Finally, recommendations are drawn from key findings of interviews and literature review.

## Advancing Lean Implementation within Highways England SMEs- Research Process

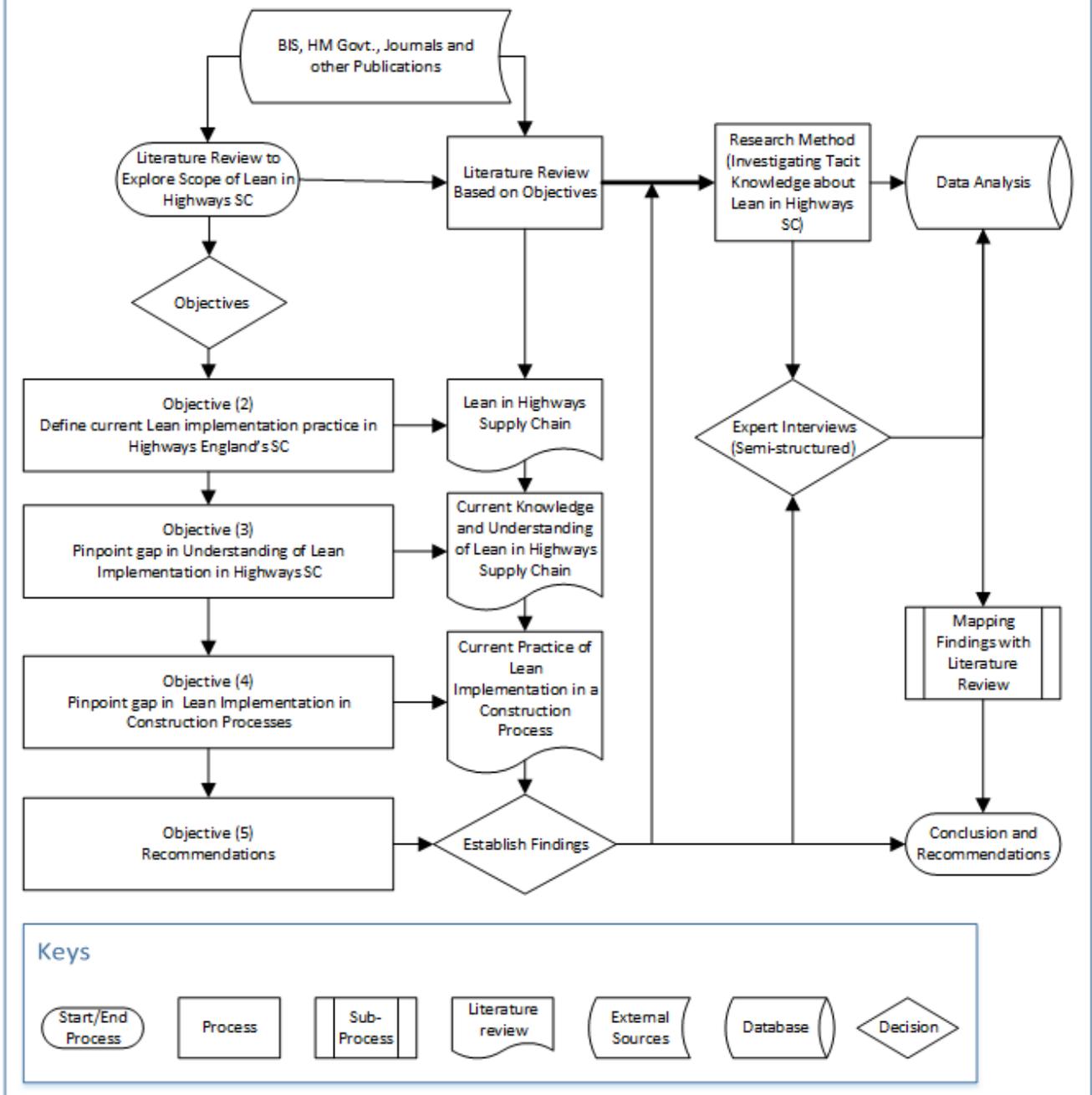


FIGURE 1: RESEARCH PROCESS

TABLE 1: INTERVIEWEE PROFILE

No	Interviewee Position	Organisation's Role in the Supply Chain	Main Operational Area
1	Senior Manager	Tier 2 (SME)	Civil works
2	Senior Manager	Tier 2 (SME)	Civil Works
3	Senior Manager	Tier 2 (SME)	Telecoms
4	Senior Manager	Tier 2 (SME)	Telecoms
5	Senior Manager	Tier 2 (Large Contractor)	Aggregate/ Surfacing
6	Senior Manager	Tier 2 (Large Contractor)	Aggregate/ Surfacing
7	Senior Manager	Tier 1 (Large Contractor)	General Contracting/ Scheme Management
8	Senior Manager	Tier 1 (Large Contractor)	General Contracting/ Scheme Management
9	Senior Manager	Tier 1 (Large Contractor)	General Contracting/ Scheme Management
10	Senior Manager	Tier 2 (Large Contractor)	Traffic Management
11	Senior Manager	Tier 2 (SME)	Civil Works
12	Senior Manager	Tier 2 (Large Contractor)	Surfacing
13	Senior Manager	Tier 1 (Large Contractor)	General Contracting/ Scheme Management
14	Senior Manager	Tier 1 (Large Contractor)	General Contracting/ Scheme Management
15	Senior Manager	Tier 2 (SME)	Electrical Works
16	Senior Manager	Tier 2 (SME)	Surfacing
17	Senior Manager	Client (HE)	Lean/ Process Improvement Department
18	Senior Manager	Client (HE)	Lean/ Process Improvement Department
19	Senior Manager	Client (HE)	Lean/ Process Improvement Department
20	Senior Manager	Client (HE)	Lean/ Process Improvement Department

## 2 Main Findings

According to the Department of Business Innovation and Skills, small firms account for 99.3% of all private sector businesses in the UK, 47.8% of private sector employment and 33.2% of private sector turnover. 18% of all SMEs in the UK private sector operate in the construction sector. A key focus of recent EU and UK policies (e.g. EU Directive 2014/24/EU) has been on facilitating SME involvement within the procurement process and capturing consequent benefits.

As part of its Lean Strategy, Highways England promote a structured approach to enhance Lean Maturity, with focus on five supporting themes of 1) Collaborative Planning, 2) Visual Management, 3) Problem-Solving, 4) Benefit Realisation and 5) Knowledge Transfer. However, interviews done as part of this project indicate that Lean approaches are not fully embedded and widely adopted by SMEs

working for Highways England. Before committing to Lean adoption, SMEs are seeking surety about the benefits of Lean adoption against the implementation cost. This study reveals that current Lean implementation focus of Highways England is primarily on Tier 1 of the Supply Chain. A strategic long-term focus for Lean Construction need further development at SME level (i.e. at level of Tier 2 and Tier 3 Suppliers).

The current Lean Construction training mechanisms (e.g. the FliTe training), just cover basic Lean concepts and are not continuous. It is important to convey the concept that Lean is essentially a “Learning by Doing” journey where teams have to get their hands dirty and identify bottom-up Kaizen (a *Japanese business philosophy of continuous improvement*) initiatives. Ultimate objective is to get to a point where Supply Chain members are practicing Kaizen on a daily basis and taking corrective actions to address problems, as and when they become visible.

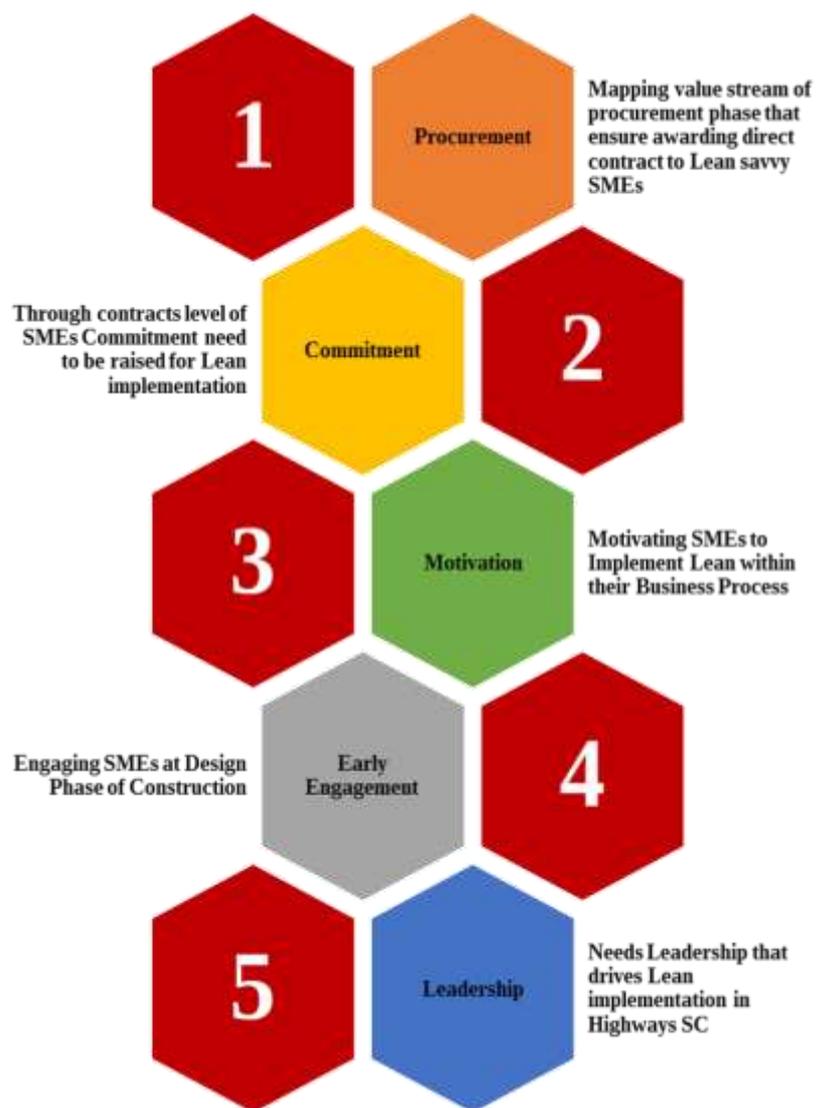
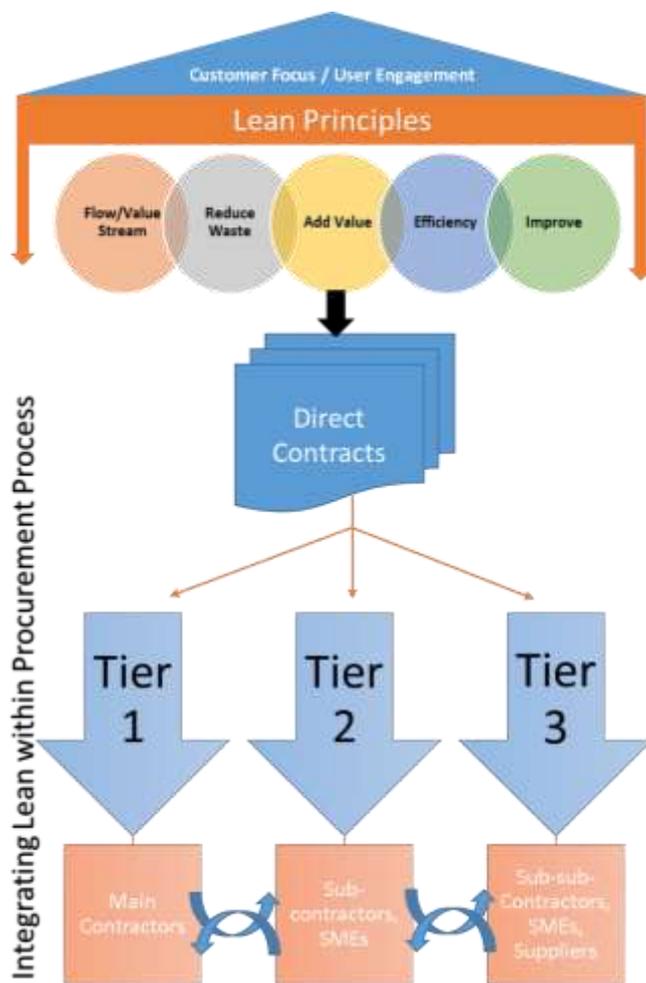


FIGURE 2: MAIN FINDINGS-1

Such an approach to continuous improvement through experimentation will require addressing existing attitudes towards risk. Currently, risk aversion within SMEs is too high to promote “Learning by Doing” Lean initiatives within Highways England Supply Chain. Some Lean principles (i.e. Collaborative planning, Visual Management etc.) has been applied in a fragmented manner, as opposed to a holistic Lean production system approach. This leads to creation of certain pockets of best practice, with organisation slipping back to previous processes because of lack of adoption of new improved approaches as standard operating procedures. For example, many construction & maintenance performance issues stem from the initial design. However, generally the SMEs have a little say on the design stage of construction. Therefore, the cooperation between the organisations in the Supply Chain to drive Lean Construction is limited and fragmented. Moreover, the external training mechanisms run by consultants and Tier 1s are the main formal training mean for Lean Construction. Although the SMEs constitute the largest portion of the Highways England Supply Chain, however, the focus of Lean initiative appears to be targeted primarily towards Tier 1 suppliers.

“Lean Support to Highways England 2015-2020” spells out that “**objective of Lean is to get value to flow at the pull of customer and then improve each day**”. Achieving aforementioned objective of getting value to flow at the pull of customer, will require a constant strive to improve processes, which



INFOGRAPHIC 4: INTEGRATING LEAN WITHIN PROCUREMENT PROCESS OF HIGHWAYS ENGLAND

discourage and/or prevent collaboration with Tier 1 contractors. Generally, held view is that the lowest price is generally a priority for awarding sub-contracts to Tier 2/3 contractors. Whilst Highways England has a clear focus on achieving cost and quality, this is not mirrored within sub-contracts. A clear emphasis on quality (e.g. defects reduction) will help achieve optimised processes. It needs integrating Lean in procurement to improve and streamline procurement and supply management processes and practices. In addition, to improve efficiencies and performance, minimise transactions, eliminate wasteful activities, reduce total cost, satisfy stakeholders, and work with the best possible suppliers who meet requirements and performance expectations.

*“Certainty and continuity of workload for Tier 2 & 3 contractors will provide maximum efficiency gains and deliver best value rather than current uncertainty of work due to budget constraints - this is nothing new and despite assurances from Highways England now their budget is ring-fenced nothing seems to have changed.”*

*(Senior Manager, Tier 2)*

Another expressed view was that contracts between Tier 1s and SMEs are mostly conventional unit price or lump sum contracts, which does not incentivise innovation much (no share the pain and gain).

deliver aforementioned value. This in turn requires developing a collaborative working and Kaizen (i.e. Continuous improvement) mindset. Rather than relying on selective experts to champion Lean or using touch management measures (e.g. mandating use of Lean as part of the procurement process), focus should be on developing virtuous circles of steady “daily improvements”, “good thinking” and “good process improvements” involving all stakeholders.

### 2.1 Need to Better Integrate Lean within Procurement/Contracting Processes

Highways England is aiming to re-balance the contract and procurement centric practices with value enabling relationships (Highways England, 2016). The ambition is to build excellence (through agile routes to capability and building intelligent informed value chains), create value (through building collaborative relationships), and enabling delivery (through creating effective programmes and realising actual performance) to deliver better outcomes for customers (Highways England 2016).

However, the SMEs are concerned that the current Highways England Procurement Procedures (primarily, secondary competitions)

From this perspective, there is scope for commercial (contract) teams within Highways England and Tier 1s to address various barriers which prevent Lean Construction deployment at the SMEs and in the Supply Chain in general.

Highways England should ensure that the wasteful activities are removed and value is added to the process, if aforementioned strategic outcomes are to be achieved. Lean principles should be implemented within the procurement process. Moreover, the current Type B contracts (conventional unit price or lump sum) between Tier 1s and SMEs should be replaced with Type C contracts (share the pain and gain at the end of a Scheme type) for a better incentivisation for Lean Construction at the SMEs (Tier 2s and Tier 3s). Having direct and long-term contracts with SMEs (Tier 2 and Tier 3) will raise the level of stake and level of liability and provide certainty to all stakeholders (Tier 1, Tier 2 and Tier 3) for Lean implementation.

## ***2.2 Need to improve commitment to implement Lean by developing a common understanding of what “Lean” involves***

There is a need to develop a better understanding of Lean across the Highways England Supply Chain and within SMEs. Generally, held perception within SMEs is that Lean is a cost-cutting efficiency improvement process improvement methodology, using various tools such as Visual Management, Collaborative Planning etc. It is generally seen as an approach focused primarily towards operations. During course of the research, research team spoke to various teams from within Highways England Supply Chain. Very often the response to question on how you approach Lean was that “We do not do Lean here”, with Lean being seen as a cost-cutting approach focuses on operations. This limited understanding of Lean tools and techniques and its benefits likely to lead to pockets of best practices whilst not providing the necessary continuous improvement status of a true Lean Enterprise. However, organisation as whole, failing to achieve status of a true Lean Enterprise. It is important to drive the view of Lean as a business strategy supported by top management within Highways England, to help transform SMEs and people through an innovation driven culture where teams are continuously improving through innovations and controlled experimentation and are implementing Lean by practicing Lean on a daily basis. Using Lean tools and techniques regularly and collecting evidence before and after implementation of Lean will demonstrate the benefits, not only to Highways England but also to the Supply Chain organisations.

There is a need to develop a better appreciation of Lean Construction within Highways England Supply Chain, and a recognition of the fact that it is more than a cost savings or efficiency improvement method. Rather Lean involves a “Continuous Improvement” strategy and a constant strive to reflect on and innovate existing processes. To further, communicate across the whole Supply Chain that Lean has become an integral part of Highways England business practices and viewed as a major important enabler to deliver expected outcome benefits.

Using its influence as a client organisation, Highways England is expected to improving the level of commitment to implement Lean in construction (e.g. use of Lean as part of procurement and contractual processes). In addition, the organisational support and commitment for Lean Construction should be increased across the Highway England Supply Chain. The commitment for Lean integration can be gained through raising both the level of stake and level of liability. The contractual agreement must clarify the gains and benefits an SME are likely to get in return of Lean implementation.

## ***2.3 Motivating SMEs to implement Lean in a Highways Supply Chain***

Rather than focusing on practical benefits of Lean implementation, currently the main motivation for the SMEs for Lean Construction is Highways England and Tier 1s' Lean impetus ("If you are not doing Lean, you are not working for Highways England"). The level of Lean Construction deployment is not an important, direct parameter for the SMEs to win future contracts under present contract conditions. The current allocation of funds & resources act as mentors for Lean Construction in the

Supply Chain is not enough. Therefore, this study identifies that SMEs have unclear goals for Lean implementation and lack of incentives for systematic Lean implementation

This report suggest that the contractual agreements must specify the clear goals to SMEs for Lean implementation. However, specifying clear goals is not enough; Highways England should understand the training and support need by SMEs. In addition, the incentives for reaching high level of Lean Maturity needs clear definition within the business cases of tender stage and used in Key Performance Indicators (KPIs) to ensure practices follows promises. Moreover, Highways England need resources to act as mentors within its Supply Chain. Mentors should work closely with the Supply Chain to assure that the SMEs are motivated to implement Lean within the organisation and the project that is being delivered.

## 2.4 Engaging SMEs early for Lean Implementation

**“There is a lot of talk about Lean by Tier 1's but I see very little on the ground at site. It's a nice idea but in reality contracts are let too late for Tier's 2 & 3 to be able to make a real impact on this agenda.”**

(Senior Manager, Tier 2- Large Contractor, General Contracting/ Scheme Management)

Highways England needs to engage more with SMEs and set clear targets, instead of going through Tier 1s. SMEs would benefit from direct contact with Highways England for their Lean implementation efforts (i.e. "Asset Led Delivery Framework"). A strategic long-term approach for Lean Construction need development at SMEs. Forming long-term alliances with Tier 2 and 3s for different schemes will help the SMEs to adopt Lean practice.

In pre-procurement engagement with the SMEs, for schemes will help them better understand ‘Why’ to design and improve their Lean implementation processes to deliver the targets set with Highways England. The SMEs should have a say in the design stage to better execute their process improvement and Lean Construction efforts and understand ‘How’ Lean should be implemented. Learning ‘Why and How’ to implement Lean through engagement of Tier 2 and 3s in Highways England supply chain likely to provide the opportunity to align the strategic support required by the SMEs.



FIGURE 4: MAIN FINDINGS-2

## **2.5 Need for strategic support to implement Lean in Highways England SMEs**

SMEs contends that Highways England and Tier 1s' work procedures and specs are too rigid and bureaucratic to enable SMEs to make process improvements through Lean tools and techniques. In addition, Tier 1 want to implement Lean quickly and through imposition of a top-level management (top-down) approach. As a result, the actions are implemented in several projects at once. Therefore, the SMEs feels there is a lack of a real top management support (buy in) for Lean Construction and strategic alliances and Supply Chain integration are limited for Lean implementation.

Lean implementation for SMEs needs, direct collaborative initiatives between SMEs and Highways England. Whereas, leadership and business strategies are aligned for not just to implement Lean but also to support SMEs for Lean implementation journey. This collaboration is essential to driven down the view of Lean that it is about targeting waste from value adding activities to develop more value to company and client and understanding value from Highways England viewpoint. However, internal power struggle between Main contractors delays Lean implementation due to different understanding of Lean implementation and different systems and approaches used. Highways England need to iron out and address the issues upfront. Such issues (power struggle, distinct understanding different system and approaches to implement Lean) needs clarification with Main contractors to drive collaborative Lean Vision in Highways England Supply Chain.

Moreover, too much emphasis on Lean tools (e.g. Collaborative Planning, Visual Management, Problem-Solving, Benefit Realization, and Knowledge Transfer) often does not help. This could lead to a misleading misconception within SMEs that Lean comprises set of tools to drive down costs or fix problems. The viewpoint of Lean as a continuous improvement business strategy and “being Lean in ones thinking” rather than “Implementing Lean Tools” need to be driven.

SMEs need the right people in the right positions across organisations who are empowered and supported in making change. Leadership support is an essential factor for the approach to implement Lean in construction. Moreover, senior management of construction felt that “any policy to pursue the trusting way of working had to come from the director level”. Director level - means the leadership. The role of senior management and leaders is essential to implement Lean. Since, Egan, (1998) reported that, committed leadership is required to drive forward an agenda for improvement. Later, Implementing Lean in construction includes the importance of building trust through leadership. Leadership is vital for construction industry. This is because Lean implementation initiative in construction required effective vision, leadership, coherent strategies and structures and respect for people along with trust (Anumba et al. 2008).

**“In construction, it is a commercial benefit to emphasise the mistakes of others rather than to help them fix them. Until this culture is changed Lean will always be an add-on or a marketing exercise.”**

(Senior Manager, Tier 3)

## **2.6 Aligning business strategies for Lean Implementation**

The broad use of term ‘business strategies’ is equated with development of a compelling and shared view of Lean implementation in construction. Business strategies establishes pre-implementation success factors of Lean initiatives in inter-personal relationship and leadership. Business strategies must be aligned at inter-organisational level (Arif et al. 2015). This also require the capability building of the organisations and individuals to deliver and innovate to implement Lean in construction. To drive the success of Lean Construction, clear and well-planned business strategies are required. However, this study reveals that the Tier 1 and SMEs in a Construction Supply Chain still lacks business strategies to manage Lean implementation. In addition, well-planned business strategies are essential to drive Lean initiative, leadership, and motivation and to build Lean Construction capability. Highways England currently assesses Lean Maturity via use of Highways England Lean Maturity Assessment (HELMA). Key focus of HELMA is Tier 1 contractors. HELMA does not link very well

with Tier 2 and 3's contractors/SMEs. Key limitation of HELMA is that it is done at an organisational level and not at a level of a Scheme. Ideally, HELMA should be done at level of a Scheme. There should be a clear Scheme focus on how Tier 1s support Lean within its Supply Chain. FLiTE training is paid for by Scheme, so it makes sense that HELMA is also done at Scheme level. There should be clear emphasis on Main contractors to drive Lean within its Supply Chain, Tier 2s and Tier 3s. At Scheme level, there is limited understanding of Lean and it is not pushed hard enough. For lot of Tier 2s and Tier 3s, Lean just become a tick box exercise.

- If a Tier 1 Contractor is at high level of maturity, their Supply Chain must be at same level. If HELMA is done at a Scheme level, it likely to be more effective. Supply Chain belongs to Scheme and not to a Tier 1 contractor. Thus, Lean Maturity must be done at a Scheme level, not for Tier 1 contractors.
- HELMA must address Supply Chain engagement aspects. HELMA is currently done at an organisational level, and split between organisation and Scheme is not clear. Focus of HELMA should be to encourage standardised Scheme based processes.

## **2.7 Providing training and support for Lean implementation**

**“A lack of understanding of Lean and a failure to drive Lean right from the highest paid executives in organisations fundamentally affects the deployment of Lean”**

(Senior Manager, HE, Lean Process Improvement Department)

The SMEs should better understand the Lean terms like value, waste and flow. Currently, the SMEs have started engaging to support the Lean Construction practices led by Tier 1s (i.e. collaborative planning). However, they do not have much going on within their own organisations. Due to lack of a complete systems thinking, some improvements made by an SME (i.e. asphaltting) can put extra workload or pressure on the other(s) (i.e. traffic management) in the same Scheme. SMEs feel that Lean Construction has been rushed and pushed on them from top without much deep understanding. Lean manager is appointed in each Scheme. However, Lean manager is an insular position. It means one person pushing Lean agenda and limited buy in from the group. It should be a group activity, with group of people bouncing ideas and looking into problems across programmes, not just one Scheme. It is important to understand that Lean initiative is not limited to selected individuals.

**“The SMEs are mostly cash sensitive and working on little profit margins; therefore, are looking for hard evidence and incentives for Lean Construction and for further deployment at their organisations.”**

(Senior Manager, Tier 2- SME)

The study reveals that SMEs needs Lean deployment at their organisations to advance the knowledge and understanding of implementing Lean in the construction. Moreover, an SME start working generally on a short time scale and are not given enough notice to be able to prepare resources and plan for a Lean implementation.. In addition, the SMEs generally do not have an internal Lean Construction training mechanism. The problem lies in the application of specific Lean techniques (i.e. collaborative planning) is not standardised enough and generally differ from one organisation/project to other. A few SMEs argues that the short-term Supply Chain relationship in construction hinder the advancement of knowledge and understanding of benefits of Lean Construction. It is because, the training and support provided by Tier 1 is inadequate.

Often problems are looked into at Scheme level – however, knowledge is not transferred across various schemes and across various programmes. For instance, all schemes suffer from logistics related issues. For instance, you order 100 Tonne aggregate and receive delivery of only 50 Tonnes. Such problems are common across all projects however; all Lean managers manage it in different ways. Likewise,

problems with drainage. It will gain by doing a Kaizen for the problem. It appears even though if there is willingness from Tier 2 and Tier 3, often good ideas are not implemented because of lack of support from T1 Contractors or Highways England.

**“The current Lean knowledge is superficial and limited in the Highways England Supply Chain.”**

(Senior Manager, HE, Lean Process Improvement Department)

Moreover, an SME work under time and cost pressures and cannot spare enough time and resources to improve their processes using Lean Construction. This is because; the SMEs generally have to work on short windows on site. This hampers some Lean improvement efforts and does not help much to improve the knowledge and understanding about Lean implementation. Therefore, Highways should ensure that the support for training and learning is adequate to advance the knowledge and understanding of implementing Lean within their organisation and on programme. That requires to revisit the current practice of knowledge management and communication within the Highways Supply Chain.

### ***2.8 Developing SMEs knowledge and understanding of Lean benefits***

Currently, knowledge retention for Lean Construction in Highways Supply Chain is problematic. The factors that hinder knowledge retention is the short-term Supply Chain relationship with SMEs, unclear goals, lack of commitment, lack of collaboration and interrupted and/or one way communication. When key personnel leaves the company/project, Lean knowledge is mostly lost as well. Currently, there is no effectively working SME led innovation groups that support each other's improvement activities or knowledge share. The knowledge can be captured by ensuring that any Lean improvements are reported in the tracker for the SME activity. This can be used for induction of the staff employed to carry out next work/ project/ Scheme. Such as, the construction activities (i.e. - asphalt) assigned to different individuals/originations are not communicated between them. Delivering improved Training and Support for SMEs to advance Lean capabilities is important.

There is a need for the SMEs to improve their current skills and expertise on Lean Construction. Training for Lean Construction, getting consultants on board and employing dedicated Lean Construction managers are costly for the SMEs. Tier 1s and Highways England should provide more support in those matters. Contrarily, SMEs should see the business case (benefits) for Lean Construction.

**“The SMEs seeks help and guidance on Lean implementation. The SMEs are given a short notice to attend FliTE training. Even though, they are keen to attend the training, it is hard to rearrange the diaries in such a short notice.”**

(Senior Manager, Tier 2)

Improving systems thinking in which different SMEs support each other's Lean improvement efforts in a Scheme. If SME's are guaranteed work over a 3-5 year period then they would be able to justify the investment to Lean training. Overall, organisational support and commitment for Lean Construction should be increased in the Supply Chain. Supporting the SMEs to form innovation driving and sharing work groups among each other.

### ***2.9 Developing a knowledge management approach that drives Lean implementation***

Lean techniques should be extended to the whole lifetime of the asset embracing design, planning, construction operation and management. Value based decisions and prioritising innovations are necessary to implement some Lean techniques in short working windows for SMEs. This will require SME staff in a position where they could become problem solvers and active member of a Leanorganisation. A key focus of Toyota's line approach is learning: instead of correcting the defects

after they occur, having a proactive approach to identify staff development and learning and making desired adjustments so that problems do not reoccur.

Highways England's "Lean Tracker" and "HELMA" could be improved (more user-friendly) and better promoted for the SMEs to digest and learn from successful Lean implementations in the Supply Chain. There is a need to increase awareness of long-term benefits of implementing Lean. The "Lean Tracker" and "HELMA" should be used to capture knowledge and increase awareness instead of just benchmarking or scoring system at a Scheme level.

**“Lean as a concept is integral to every good business - the requirement to use Japanese terminology and enforced techniques etc just turns people off. The Tier 2's are practical people and so if Lean was kept simple, clear and focused it would get a lot more buy in. There are also a lot of practical difficulties to implement some of the approaches across national, short duration (1 week), transient sites with a widespread workforce operating in small gangs, with no fixed office - but no-one seems to listen. It is one size fits all, as the Lean consultants just do not understand how the Tier 2's operate.”**

(Senior Manager, Client (HE))

### ***2.10 Modifying tools and techniques to share Lean's knowledge with SMEs***

There is a need for the SMEs to change their work culture for Lean Construction for more information share with each other. The Lean implementation should have a collaborative approach where all parties share equal level of liability and reward for Lean's success.

**“Current, overlay of "Lean" probably helps SMEs to provide a badge for stuff they do, but they may not be happy to spend a lot of time and effort attending workshops to be reassured of this.”**

(Senior Manager, Tier 1)

A knowledge sharing approach aligned with Lean Construction would be beneficial to drive innovation in construction. However, knowledge sharing requires commitment and motivation to share knowledge. Knowledge sharing among all tiers of Construction Supply Chain will help to advance the organisational capabilities of SMEs. This will also lead to knowledge dissemination and knowledge retention and consequently to construction innovation.

### ***2.11 A collaborative approach with SMEs for Lean implementation in Supply Chain***

**“SMEs need to incorporate Lean principals into their processes and work flows in order to remain competitive in this very demanding market. Fat has already been trimmed and organisations are working as hard as they can to deliver and stay afloat.”**

(Senior Manager, Tier 2)

Continual improvement and streamlining are already incorporated into the business but this is difficult to prove in a formal manner. The amount of influence that SMEs have on a large Scheme is extremely limited. “Highways England and Tier 1s needs listening to SMEs” (Senior manager, Tier 2, SMEs). It is expensive for smaller organisations to participate in formal training and documentation/auditing of Lean. Highways need a direct collaborative approach with SMEs to ensure they are listened. Moreover, SME's have very little influence over Tier 1's but if they could capture the knowledge and share it, within their category groups there is a potential that this knowledge would be retained and re-used by the group members.



# Checklist

- ☑ Integrate Lean within Procurement/Contracting process
- ☑ Raise the level of stake and level of liability of SMEs for Lean implementation through direct contracts
- ☑ Improve SMEs Commitment to implement Lean
- ☑ Motivate SMEs to implement Lean in Highways England Supply Chain
- ☑ Early engagement of SMEs to ensure Lean implementation in Supply Chain
- ☑ Provide strategic support to SMEs
- ☑ Implementing Lean is a grand Scheme rather than an individual initiative
- ☑ The “Lean Tracker” and “HELMA” should be used to capture knowledge and increase awareness
- ☑ Develop a Knowledge Sharing approach within Highways England Supply Chain
- ☑ Advance Knowledge Sharing tools and techniques whilst modifying current tools and techniques of sharing Lean’s knowledge with SMEs

### 3 Scope of Lean Implementation within Highways England Supply Chain

Lean Construction can provide innovative ways of managing work over the life of a Highways development project. It is important to recognise that Lean Construction is not merely a productivity improvement programme (Sacks et al. 2010; Sacks et al. 2009b). It is a production management-based approach to project delivery; it is a new way of designing and building capital facilities (Sacks et al. 2009a). The application of Lean production management to manufacturing caused a revolution in terms of productivity growth. The objectives of Lean production systems are to maximise value and minimise waste within specific techniques and to apply those techniques to form a project-based production system (Childerhouse et al. 2003). Lean Construction is particularly useful on complex, uncertain and quick projects.

In construction context, Lean is an operational excellence strategy that enables better change. Kaizen, in Japan means ‘change for good’ is the basic philosophy of Lean. However, the Lean process is slow and steady, instead of quick and vague (Dombrowski, et. al, 2012). The Japanese views that, Lean principles include a persistent pursuit in the elimination of waste, where waste means any activity that adds no real value to the product or service. Moreover, the Japanese thought of Lean, is not only to eliminate the waste that increase the value, but also increase the speed of the processes that increase flow. Pheng & Fang (2005) gave eleven Lean principles while naming them the modern-day Lean Construction principles. However, those Lean principles relates to the main aim to increase the value, increase flow and uninterrupted improvement and delivering what the customer wants at the customer demanded rate. Later, Sacks et al., (2009) said that, like in the Toyota Production System, the focus in Lean Construction is on reduction of waste, increase of value for the customer, and continuous improvement. Moreover, Sacks et al., (2009) considered four types of Lean principles focused upon the analysis of interconnection of Lean and BIM. Those four principles were philosophy, process, people, partners and problem-solving. They concluded with four processes areas namely, flow process, value generation process, and problem-solving, as well as developing partners. In addition, the continuous improvement principle is considered as embedded within the flow process. However, according to Pheng & Fang, (2005) continuous improvement or quality management should be seen as a separate process.

Based on literature, table 2 and 3 are developed to establish the interpretation of common characteristics and relationships between them.

TABLE 2 – APPLICATION OF LEAN PRINCIPLES IN HIGHWAYS ENGLAND SUPPLY CHAIN

Lean Principle	Characteristics	Application within Highways England’s Supply Chain
<b>Value</b>	To generate and add value to a construction process while removing waste from it	A clear definition of Highways England customers (both internal and external) and definition of what constitutes value is the starting point to attack non-value adding activities or waste.
<b>Waste</b>	To improve the construction process, while removing unwanted activities (waste) from it	Elimination of all non-value added activities that hinder the flow and efficiency of delivering the customer demand.
<b>Flow/Value Stream</b>	To enhance the flow of materials and information within construction processes	A flow/value stream is the entire set of activities within the Highways England’s Supply Chain. This consists of the end-to-end process that deliver value to the customers.
<b>Efficiency</b>	To increasing efficiency of construction processes	The Highways England urges Main contractors to understand and increase efficiency to deliver customer demand- what and when it is required.
<b>Continuous improvement</b>	To continuously improve the construction processes until the desired results are achieved	To be bold and challenge some of our current practices, working with suppliers to continuously improve.

TABLE 3: MAPPING RELATIONSHIPS BETWEEN KEY LEAN PRINCIPLES AND ITS IMPLEMENTATION WITHIN HIGHWAYS ENGLAND

No	Relationships Between Lean Principles	Implementation in Highways Perspective
1	<b>Waste ↔ Value</b>	Removing waste (unwanted activities) generates value through a process while reducing cost and lead-time to perform the process. In other words, removal of waste from a process helps to generate value in it.
2	<b>Waste ↔ Flow</b>	Removing unwanted activities from a process enhances the flow of material and information. For example, removal of unwanted tools or equipment that hinder the flow of workers or vehicles at a construction site would increase safety of workers, quality of work and reduce the process time.
3	<b>Waste ↔ Efficiency</b>	Removing unwanted activities from a construction process increases efficiency of workers to generate value, increase flow and helps to efficiently deliver the value to clients.
4	<b>Waste ↔ Continuous Improvement</b>	Removing unwanted activities from a process improves the process, but continuous improvement initiative commits to eliminate the waste from the entire process. In Highways England, continuous improvement require collaborative planning (integration between multiple contractors to enable confident delivery) and efficient production management to improve Supply Chain processes. This may require addressing commercial/contractual constraints to collaborative working.
5	<b>Continuous Improvement ↔ Value</b>	To generate value in Highways England Supply Chain requires continuous improvement of a process until the perfection is achieved. Generation of value needs, understanding the value stream, removing waste from it and enhancing the flow while eliminating the activities that hinders the value generation process.
6	<b>Continuous Improvement ↔ Flow</b>	Enhancing value stream while removing unwanted activities from a process and keep doing it will continuously improve the process and inversely. In Highways England, continuous improvement support improved environment and more accessible and integrated network to deliver value to clients.
7	<b>Continuous Improvement ↔ Efficiency</b>	Continuously improving the value stream while reducing waste, enhancing flow and generating value helps to deliver performance and efficiency. The commitment to Lean principles and reaching perfection to deliver the customer (what and when it is asked for) encourages collaborative relationships.
8	<b>Flow ↔ Efficiency</b>	Mapping end-to-end value streams of Highways Supply Chain helps to understand value and deliver efficiency improvement. It supports to develop efficiency of people through collaborative planning. In addition, it benefits in advancement of problem-solving skills and encourage Knowledge Transfer.
9	<b>Flow ↔ Value</b>	Advancing the value stream at Highways England not only generate value for clients or customers it supports value generation for suppliers through Lean Value Contribution Plan that supports Highways England KPIs.

Above interpretive correlations gives the understanding of working and unique characteristics of application of Lean principles in Highways England’s Supply Chain. The main principle of Lean thinking is to remove waste (unwanted activities) from the value stream to increase flow. Other principles of Lean are often dependent on the value identification and generation waste reduction and provide limited efficiency to a Supply Chain and especially to a set of multiple Supply Chains of a construction project. In short, adopting Lean thinking in Highway’s Supply Chains would help to generate value and consequently, to reduce cost and lead-time to deliver end-to-end process.

#### 4 Implementing Lean in Highways Supply Chain

**The objective of Lean is “to get value to flow at the pull of the Customer and then improve each day”.**

(Highways England 2015)

A process is a specific ordering of work activities across time and place, with a beginning, an end, and clearly defined inputs and outputs. A Lean Process is the structure by which the organisation performs only the necessary activities that produce value to its customers.

In Highways Supply Chain, a process mapping (Value Stream Mapping) is characterised with the five main divisions, Mega-process, Major-process, Sub-process, Activities and Tasks. The value stream of Highways Supply Chain can also be characterised by the level of contractual agreements such as Tier 1 (Main Contractors), Tier 2 and 3 (Sub-contractors) and beyond.

A mega-process is the highest level of processes identifies by an organisation. It is a combination of more than one major-process (Capgemini 2004). Mega-process usually forms a core value chain for an organisation. A major-process is a sub-division of mega-process and is a combination of several sub-processes and a sub-process is a combination of several activities. An activity is a unit of work performed by one job function at one time with one mode of operation. Each activity can have several tasks. A task is a work step performed to complete an activity.

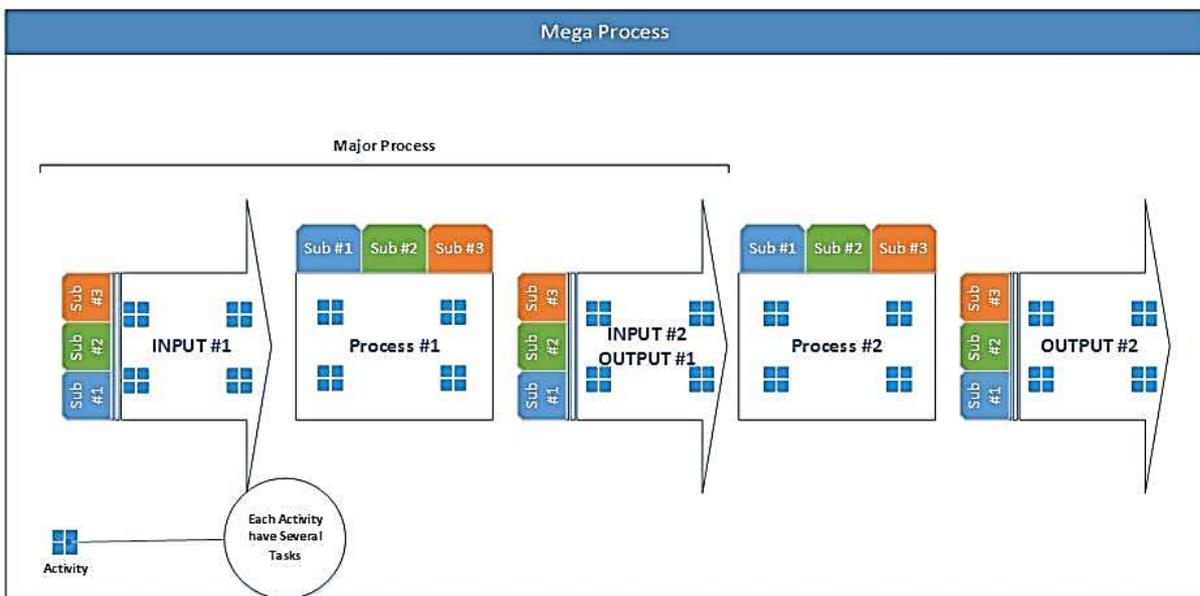


FIGURE 5 - CONSTRUCTION PROCESS HIERARCHY

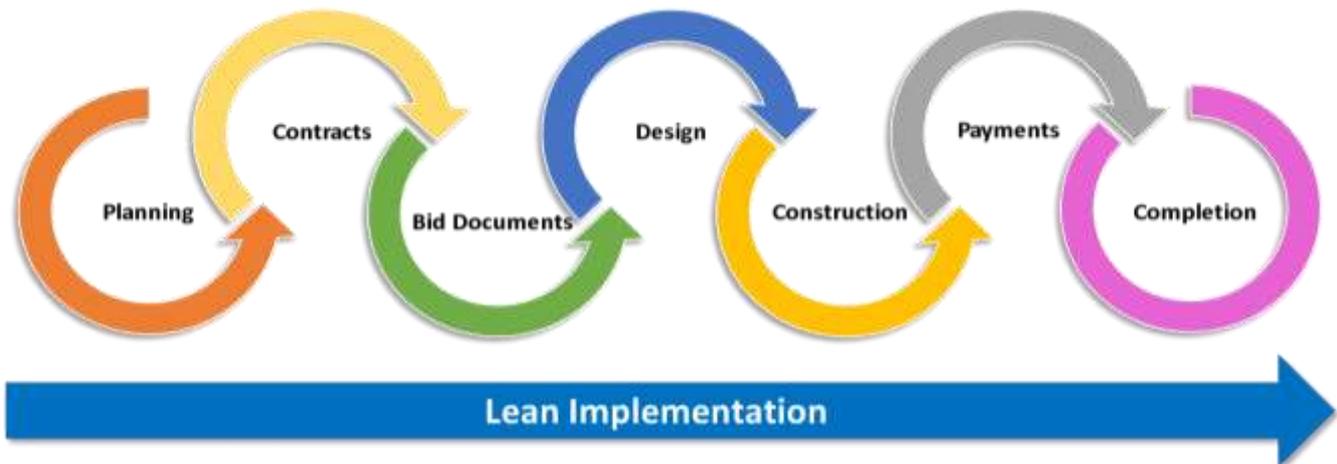


FIGURE6: IMPLEMENTING LEAN IN CONSTRUCTION PHASES

A series of processes that works on the Lean principles towards one goal adds value to the self and following processes and across the whole set of manufacturing processes (Jørgensen & Emmitt, 2008; Koh, et. al, 2008). In Lean process, the focus is to improve each task on the way to improve to make it Short, Straighten, Shine, Standardise, and Sustain (5S of Lean) and to reduce wastes (Womack & Jones, 2003).

Non-Value Added type activities need to be removed such as excessive motion involved in a task (Womack & Jones, 2003). If tasks within an activity are subsequently improved, it adds value to the activity. In addition, a group of improved activities brings value to the sub-process and afterwards major-process and at the end, mega-process levels (Lin & Tserng, 2003).

In reality, Lean in construction is not just to remove waste from the construction process or to make standardised material to use in construction projects.

***Lean is mainly to improve the construction process to develop innovative and sustainable construction.***

To get the benefits of Lean, aforementioned principles require implementation within the entire construction project and within the organisations involved. Below figure 3 shows the simple Lean Supply Chain of a construction project. In this figure, there are two sets of a Supply Chain. In the Supply Chain #1, the Supply Chain is mainly concerned with the Tier 3 suppliers that are often SMEs in Highways Supply Chains. In addition, Supply Chain #2 is concerned with the main Supply Chain of the construction project with Tier 1 (Main contractors) and Tier 2 (sub-contractors). Below figure 4 is an outcome of the literature of Lean Construction and Construction Supply Chain. The implication of Lean is in one organisation and its process levels.

***“Organisations handling Lean Construction projects must implement Lean principles on each level of construction (throughout a mega-process, major-process, sub-process, and activity and task levels).”***

(Saini, 2015)

Failure to employ these principles, will lead to non-achievement of the stated goals/objectives, as all the departments in the organisations are interconnected. Therefore, Lean must be implemented at all stages (planning, contracts and bid documents, construction, payments and completions) of

a construction. However, implementing Lean in lifecycle of a construction project is highly challenging.

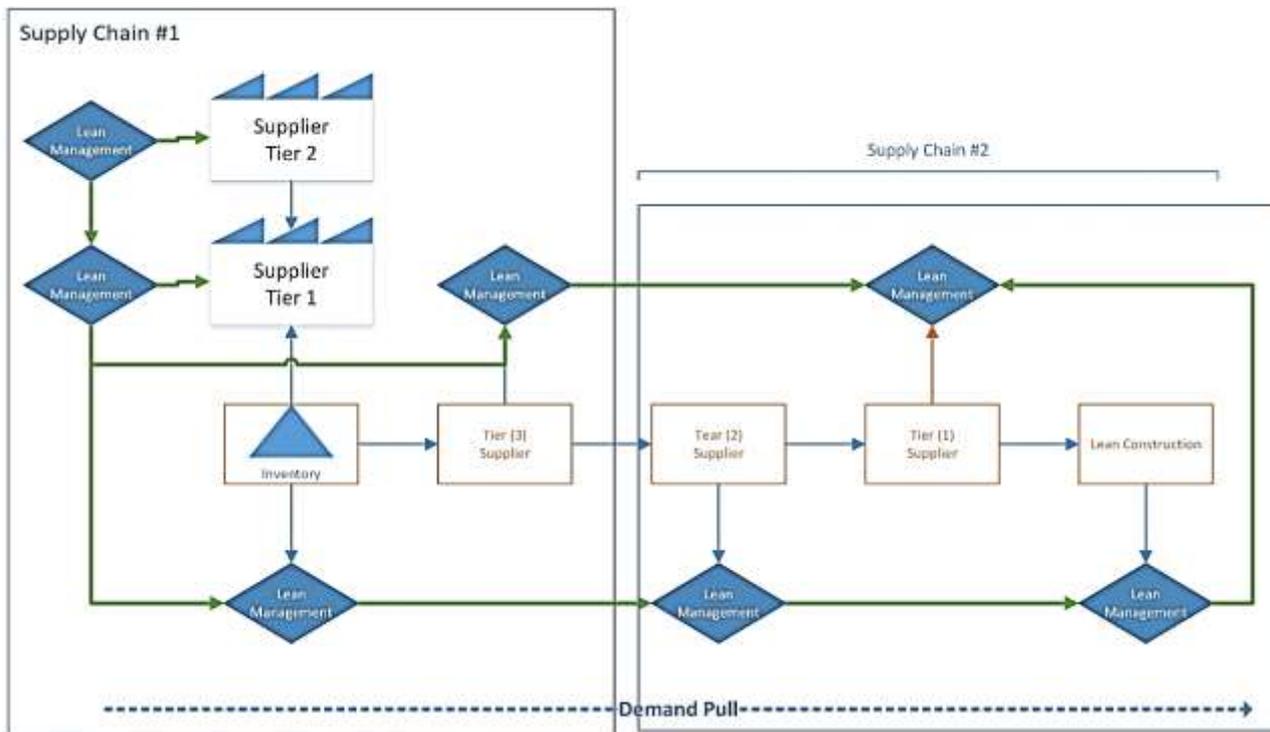


Figure 3: Implementing Lean in Highways Supply Chain

Similarly, the organisational hierarchy divides the Highways Supply Chain. This hierarchy consists of the organisations based on the contractual terms. It divides the Supply Chain into different segments such as Main Contractors, Sub-Contractors, Sub-sub-contractors and suppliers. This organisational hierarchy in the Highways Supply Chain are often known as Tier 1 (Main contractors), Tier 2 (Sub-contractors) and Tier 3 (Sub-sub-contractors) and beyond. The Tier 2, 3 and beyond of Highways Supply Chain are mainly SMEs. The UK's construction industry stands as a SMEs led industry. The construction industry has about 99 percent of SMEs. Therefore the Highways England relies on the SMEs those jointly makes a massive contribution to the Highways Supply Chain.

As aforementioned, success of Lean implementation in Highways Supply Chain requires implementation of Lean principles at every level of Supply Chain. Therefore, Lean initiatives can only be successful if Lean is implemented at all levels of organisational hierarchy in Highways Supply Chain. Whereas, Tier 2, 3 and beyond is the most important segments. However, **making construction SMEs (mainly, Tier 2 and 3 of Highways Supply Chain) Lean-ready is challenging.** Challenges of implementing Lean in those SMEs are identified below.

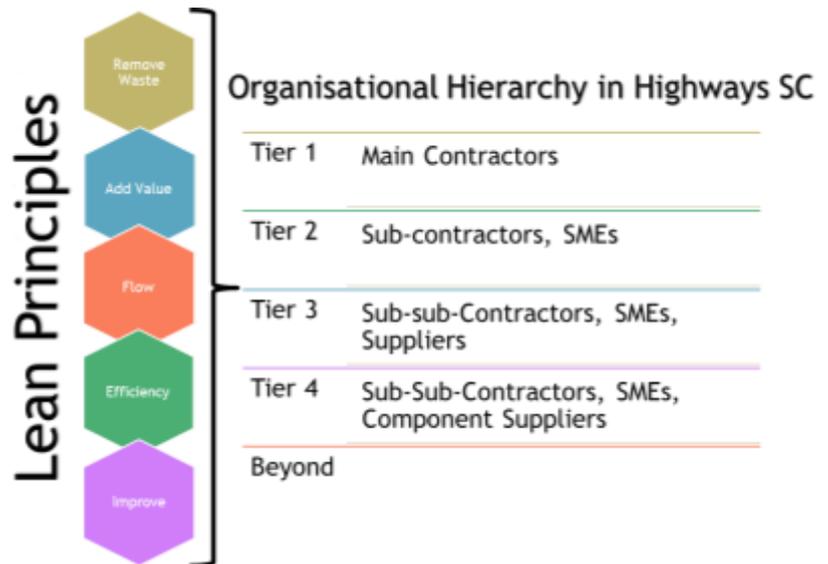


FIGURE 8: IMPLEMENTING LEAN IN ORGANIZATIONAL HIERARCHY IN HIGHWAYS SUPPLY CHAIN

## 5 Conclusions

From the evidence collected, the current focus of Lean implementation in Highways Supply Chain is on Tier 1s. The knowledge and understanding of Lean implementation and its benefits is limited in Highways Supply Chain. SMEs feel that Tier 1 (Main contractors) is forcing Lean to Tier 2 and 3, without any adequate training and support. Due to lack of knowledge and understanding of Lean, the current attempts to Lean deployment lack commitment and motivation of SMEs to implement Lean. Moreover, unclear goals and fuzzy incentives for SMEs has discouraged the level of stake and level of concern for Lean implementation. Some SMEs believe that nothing has been changed since the Lean in construction was introduced and considers Lean as an unwanted activity such as filling forms for “HELMA’s” self-assessment.

Through learning from Toyota, the Lean should be if implimented in whole supply and value chain. A successful integration of Lean in Highways Supply Chain requires timely information exchange and communication throughout the Supply Chain. The Lean Construction is an important factor for temporary organisations that need ability to integrate individual knowledge. However, lack of importance and awareness of Lean Construction in short-term Supply Chain’s, temporary organisations face particular obstacles. We learned that the most SMEs are not aware about the tools and techniques of implementing Lean. A short-term Supply Chain perspective and collaboration make it harder to develop Lean Construction in the Highways Supply Chains. Short-term Supply Chains are often not integrated (Khalfan & McDermott, 2007). The short-term relationship encourages adverse relationship that prevents trust and collaboration. Moreover, short-term relationship is an issue that lessen motivation on construction projects.

We supports the view, that Lean in construction is not sucessful if implimented in just one section of Supply Chain (i.e Tier 1) or a process. Moreover, the Lean training (i. e. FliTE) initiative require transformation from instructive (What to do) approach to directive (How to do) and supportive approach. Better communication and knowledge sharing throughout the Highways Supply Chain would be beneficial for SMEs. Moreover, the SMEs should be engaged from the foremost level of construction process to understand the need for Lean implementation and its benefits. We recommends direct and long-term contract between Highways England and SMEs (Tier 2 and Tier 3). In addition, Lean implementation in Highways England Supply Chain must be aligned with leadership and business strategies. The Lean performance measurement tools and techniques in Highways England needs review.



# Checklist

- ☑ Lean should be implemented within Tier 1, Tier 2 and Tier 3 of Highways England Supply Chain
- ☑ Lean should be implemented in all levels of construction processes
- ☑ Clear goals need defining for SMEs to successfully initiate Lean implementation
- ☑ Need to define benefits of Lean implementation for Highways England SMEs
- ☑ Lean implementation should be driven by customer focused vision within the Highways England Supply Chain
- ☑ Support to SMEs- the Lean training (i. e. FLiTE) initiative require transformation from instructive (What to do) approach to directive (How to do) and supportive approach
- ☑ SMEs should be engaged from the foremost level of construction process to understand the need for Lean implementation and its benefits
- ☑ Lean implementation in Highways England Supply Chain must be aligned with leadership and business strategies
- ☑ The Lean performance measurement tools and techniques in Highways England needs review

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