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Lean Thinking: Theory, Application and Dissemination

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Lean Thinking: Theory, Application and Dissemination

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HUDDERSFIELD

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Foreword

Faced with the prospect of needing to make over 4% real time efficiency savings, the National Health Service is facing its greatest challenge since it was founded in 1947. There is the challenge of demographic changes which will see an increase in children, as well as a huge increase in people over the age of sixty five over the next ten years. Many of these people will have long term conditions and a large number will have problems with memory. These issues will place a huge burden on existing public services - most notably, on health and social care.

At a time when there isn't any new investment available to us, we are responsible for responding to that challenge and to do that we need to do things differently. The first part is to work more closely with service users and carers in their local community to transform the offer of service. Crucial to that is placing people in the centre and giving them greater control of their care. To do this we need to appreciate how, where and why services are delivered. In particular, we need to understand the processes that underpin our current healthcare delivery models. We can then eliminate waste and repetition - often described as Lean systems thinking.

Throughout 2013 and 2014 we have been working in partnership with the University of Huddersfield Business School, on projects that will transform our service offer through: improved access, improved thinking on efficiency and most importantly, on improving the lives of those who use our services. In doing so, we have utilised the latest research and thinking to help us meet the challenges that we face. This textbook summaries the lessons learned.

Steven Michael, OBE

Chief Executive Officer

South West Yorkshire Partnership NHS Foundation Trust

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Executive Summary

This book was written and compiled by the University of Huddersfield to share the learnings and experiences of seven years of Knowledge Transfer Partnership (KTP) and Economic and Social Research Council (ESRC) funded projects with the National Health Service (NHS). The focus of these projects was the implementation of Lean thinking and optimising strategic decision making processes. Each of these projects led to major local improvements and this book explains how they were achieved and compiles the lessons learnt. The book is split into three chapters; Lean Thinking Theory, Lean Thinking Applied and Lean Thinking Dissemination.

Lean Thinking Theory

An introduction to basic Lean theory and concepts is given, before outlining the benefits of applying Lean in healthcare and concluding with an international benchmarking of Lean healthcare schemes.

Originally developed by Toyota, Lean is an improvement philosophy which aims to continuously increase the efficiency and effectiveness of a system by driving out waste. In manufacturing, Lean has been successful in improving productivity and achieving cost savings. In healthcare, Lean has improved patient flow, shortened turnaround times, reduced waiting times and improved quality of care.

Why is Lean used in the NHS?

With the NHS facing productivity challenges and with pressures to increase patient safety and place patients at the centre of their care, the NHS will be required to do things differently and improve how it

manages its resources. As such, the application of Lean thinking during this tumultuous period is very relevant.

Comparison with other countries

There are similarities and differences in the way that Lean is practiced in the UK and USA:

- Similar Lean tools are used at the beginning of Lean intervention. These were Standardisation, Value Stream Mapping (VSM) and PDCA cycles.
- In the UK, Lean is used to improve flow which was associated with improving the patient experience.
- In the USA, more prominence is placed on the delivery of higher quality healthcare services.
- There are more examples of Lean in USA healthcare organisations than the UK.

Levels of Lean implementation in healthcare organisations

Lean implementation requires organisation wide commitment. Whilst individual case studies can show Lean on a local context, they can also be used as an indicator of the 'Leanness' of the wider organisation. There are four levels which describe an organisation's degree of Lean implementation; Education, Pilot Project, Modified and Total. Research by Papalexi et al. (2013b) classified USA and UK healthcare Lean implementation schemes using Safayeni et al's (1991), Lean Maturity Model. It showed that the USA was more advanced in terms of the maturity of their Lean healthcare schemes, with 26% classified at the Modified level – double that of the UK. The majority of healthcare organisations were considered to be at the Pilot level, whilst no healthcare organisation fell in the Total Implementation category.

Lean Thinking Applied

This chapter provides examples on how Lean thinking can be practically applied. It describes the Lean approaches used in a service improvement project, as well as several case studies demonstrating the use of Lean at a strategic level.

Improving access to healthcare
The Problem: There were significant variations within the four autonomous Single Point of Access teams (SPA) at South West Yorkshire Partnership NHS Trust. It led to differences in operational processes, inconsistent levels of service quality and performance. In particular, there were complaints from the service teams of services users being incorrectly signposted.
Aims & Objectives: Use Lean tools and techniques to: 1) establish a baseline of current SPA provisions across the Trust; and 2) develop improvement opportunities by identifying waste and constructing ways to remove/reduce their impacts
Findings: The project revealed significant process and resource variations between the four SPA teams. The root cause of a number of wastes stemmed from the way referral information was provided to the SPA Clinician. It was realised that the ability of the SPA Clinician to signpost referrals accurately was dependent on the quality and completeness of the referral information supplied.
Solution: Replace the incumbent paper referral form with a telephone based and electronic referral process. It would allow the SPA clinicians to 'pull' relevant referral information to inform their clinical decision making and ensure referral information was complete.
Outcome and benefits: <ul style="list-style-type: none">• Reduce signposting errors• Eliminate waiting for additional referral information from referrers• Remove duplication from converting paper referrals into electronic format• Potential to use Multi Criteria Decision Analysis (MCDA) to improve and standardise clinical decision

- making
- Improve relationship between primary and secondary care clinicians

Redesigning healthcare logistics

The Problem: The transport system at NHS Bradford and Airedale was fragmented and separated into patient and non-patient services. However, services were shifting from acute settings and into the community which placed a greater demand and need for the provision of different transport models in the district.

Aims & Objectives: The project looked at both patient transport, services and resource logistics provisions in the Bradford area. It involved an assessment of existing transport provisions, application of Lean thinking theories to rationalise the Trust's logistical assets, and offered recommendations for redesign.

Findings: The Trust uncovered the use of numerous disjointed transport providers. There was also significant duplication, especially in the movement of specimens and notes throughout the system.

Solution: Development and roll out of an Integrated Transport Unit in collaboration with other trusts and the local authority. This centralised and coordinated patient transport.

Outcome and benefits:

- The Trust was able to save in excess of £280,000 per year
- More efficient use of staff time (by reducing time spent on organising transport)
- More appropriate in-house vehicle fleet usage which contributed to improved ambulance response times
- Reduction in DNAs as people were less likely to waste an appointment if they could get there

Reducing the cycle time of healthcare infrastructure projects
<p>The Problem: NHS Bradford and Airedale was in the process of assessing and developing new healthcare facilities. It was recognised that there was a lack of mechanisms, systems and procedures for overseeing the development process and ensuring the new facilities were suitable.</p>
<p>Aims & Objectives: Lean construction concepts and decision making models were applied during the planning, design and management cycle of new healthcare infrastructure development projects.</p>
<p>Findings: Major bottlenecks during the Planning and Design phases were the strategic decision making for: the estates rationalisation, the site selection, the service portfolio selection and the design decisions process. Without these sets of decisions, proceeding planning and design activities were stalled, thus hindering the overall infrastructure development cycle.</p>
<p>Solution: Development of a bespoke Lean Methodology composed of MCDA models to optimise the site selection process; Performance measurement frameworks to drive innovation and continuous improvement, as well as to inform strategic decision making. Furthermore, the use of Quality Function Deployment (QFD) was used to manage the Design phase in order to amalgamate the service users' and infrastructure requirements to generate design solutions that were fit for purpose.</p>
<p>Outcome and benefits:</p> <ul style="list-style-type: none"> • The Trust was able to reduce the infrastructure development cycle time by 18% and reduce costs by 7.35%.

Challenges to Healthcare

Although there are a number of benefits associated with Lean, it does not mean that they were achieved without challenges. Reflections from practitioners found these to be:

- The organisational culture wasn't ready for change
- Difficulties in maintaining strategic buy-in and project momentum
- Availability and quality of data
- Unclear Lean programme/project plan

To manage some of these challenges, practitioner reflections suggested spending more time in the initial stages of the project to plan, clarify expectations and secure buy in from relevant individuals/parties. Redefining 'failure' as an 'opportunity to improve and learn', and celebrating success would help to increase personal resilience.

Lean Thinking Dissemination

The dissemination of knowledge and learning from Lean projects is an important yet under practiced activity. Whilst individual projects create local benefits, effective dissemination offers the opportunity for a project to have a far greater impact; expanding beyond colleagues and peers, to potentially influence policy makers and the wider health community. Based on experiences from the ESRC Lean in Healthcare project, there are a number of tools and methods that can be used for dissemination:

- *Create a dedicated project website*

A project website can be used as a central source of information that is freely and permanently available. Establishing a website for a project is useful for sharing greater quantities and more detailed information and resources in a readily available and cost effective manner.

- *Use and expand your existing network of contacts*

Dissemination typically begins by exploiting existing relationships. Making contact with people you already

know is an effective way to grow your own network of contacts. It can also maintain project momentum and ensure strategic buy-in.

- *Use social media*

Social Media can be used to communicate work, and find out about the work of others.

Feedback/responses are instantaneous and due to its web-based nature, geographical limitations no longer hinder discussions and knowledge exchange.

- *Host or attend industry seminar events*

These events can be particularly effective in engaging practitioners and reach a wider network of NHS Trusts and healthcare organisations. Answering 'call for speakers' for external seminar/conferences can gain access to new communities and individuals.

- *Use multimedia differently*

Using more interactive methods for dissemination can appeal to a wider audience and facilitate greater engagement. Examples are audio Podcasts, Video casts and the use of 'Prezi' instead of a standard PowerPoint presentation.

- *Apply for awards*

Consciously celebrate success and simultaneously increase awareness of your Lean projects by applying for awards. Even if unsuccessful, at least it would have reached the attention of those assessing it.

Introduction

This publication was compiled from the findings and methodologies developed during seven years of Knowledge Transfer Partnership (KTP) collaborations and Economic and Social Research Council (ESRC) funded projects with the National Health Service (NHS). During this period, substantial experience in implementing Lean thinking and optimising strategic decision making processes were gained. Each of these NHS KTPs has achieved very clear results and led to major local improvements.

At the core of all these projects was the application of Lean thinking. This book will share how Lean can be applied to achieve major cost savings, increase efficiency and productivity and improve strategic decision making, as well as share the best practice that arose from the three KTP and ESRC projects.

Who should read this?

This publication will be helpful for:

- Chief Executives of PCTs, NHS Trusts, DoH and other NHS organisations
- Directors: including those with responsibility for operations, strategy, performance, improvement and human resources
- NHS improvement leaders
- Service managers with responsibility for change in public, private and third sector healthcare organisations
- Academics and healthcare researchers

Presentation style

The book is divided into three chapters:

1. Lean thinking theory
2. Lean thinking applied
3. Lean thinking dissemination

Each chapter begins with an overview of its contents. Case studies are presented in white boxes, whilst definitions are can be found in grey tabs along the top or bottom of a page. Each chapter concludes with a set of questions for the reader to consider and reflect upon.

A Glossary of Terms can be found at the end of the book; containing definitions and brief descriptions of Lean terminology.

Chapter 1

Lean Thinking Theory

This chapter gives an introduction to basic Lean theory and concepts. It includes an overview of how Lean evolved from the manufacturing sector to its eventual application to the health sector. Its relevance and the benefits that it has achieved during its transference to healthcare are discussed and reinforced with UK and US case studies. These were also used to illustrate the international differences in the application of Lean. Finally, the maturity of a healthcare organisation in its application of Lean thinking is considered and the reader is introduced to the Lean maturity model.

1 Lean in the NHS

1.1 What is Lean?

Lean can be defined as an improvement philosophy which aims to continuously increase the efficiency and effectiveness of a system by driving out waste (Womack et al., 2005). In doing so, organisations can achieve competitive advantage by reducing the production cost of their goods/services without compromising the quality of their products.

The origin of Lean is widely accepted to be from the manufacturing sector developed in the 1950s by Toyota under its production system (Toyota Production System) and the application of Just-in-Time (JIT) and Theory of Constraints (TOC) (Ohno, 1988; Taguchi, 2005; Goldratt, 2004).

There are seven types of waste that Lean organisations strive to eliminate or reduce their impacts (Ohno, 1988). Understanding the types of waste and where they are arising allows an organisation to investigate them in order to develop mitigating solutions. In order to do this Womack and Jones (1997, p.12) identified five principles of Lean implementation.

Box 1: The seven types of waste

1. Transportation
2. Inventory
3. Unnecessary motion
4. Waiting
5. Overproduction
6. Overprocessing
7. Defects

Box 2: The five principles of Lean

1. Specify value according to the needs of the customer
2. Identify the value streams to realise the final product
3. Create continuous flows on critical activities
4. Apply pull systems over these flows
5. Implement continuous improvement to strive for perfection

To achieve these principles, there are numerous tools and techniques from the Lean toolkit that can be applied. Amongst the most popular are work Standardisation, Value Stream Mapping, Kaizen, 5S, A3 report, Kanban, PDSA cycles, Benchmarking, Brainstorming, and ABC analysis (Papalexi et al., 2013a). However an important aspect of Lean implementation is engagement with staff from the bottom up, as well as top level commitment and strong leadership (Institute for Healthcare Improvement, 2005; NHS Improvement, 2010). Lean requires top level management to empower and allow their staff to use their everyday experiences and expertise to identify problems, develop their own solutions and ultimately, to deliver change directly from the frontline (Waring & Bishop, 2010).

1.2 Benefits of applying Lean

The application of Lean in manufacturing has received much attention with many documented examples of when it has been successful in improving productivity and achieve cost savings (Young and McClean, 2008; Brandao de Souza, 2009). The last decade has seen the application of Lean expand beyond the manufacturing environment to other industries such as construction and public sector services (Howell &

Ballard, 1998; Macomber & Howell, 2003; Arnheiter & Maleyeff, 2005; Kollberg et al., 2006). The application of Lean in healthcare has produced measurable improvements such as improved patient flow, shorter turnaround times, reduced waiting times, and greater discharge efficiency (Papalexi et al., 2013a).

Box 3: Examples of Benefits of Lean in Healthcare

NHS Doncaster, redesigned its Transient Ischemic Attack pathway by introducing a rapid one-stop access clinic. The result was a 96% reduction in waiting time for a care (Tuck, 2009).

The Histopathology team at Calderdale and Huddersfield NHS Trust, reduced their turnaround times by 43% (Raja et al., 2008).

Virginia Mason Medical Centre, created additional capacity through waste reduction to eliminate the need to purchase additional multi-million dollar additional (Womack et al., 2005).

Denver Health Medical Centre saved approximately \$2.8 million, without reducing staffing or patient care (Shanley, 2007; Nuzum et al., 2007).

ThedaCare in Wisconsin, was able to achieve \$10 million in cost-savings due to its Lean programmes (Matzek, 2006).

1.3 Why is Lean used in the NHS?

With the NHS facing the challenge of delivering £20 billion in productivity savings by 2014/15 (King's Fund, 2011), the NHS will be required to do more whilst using fewer or similar level of resources. Furthermore, following the outcomes of the Mid-Staffordshire inquiry and the Francis Report, there are pressures to increase patient safety and place patients at the centre of their care (Mid Staffordshire NHS Foundation Trust Public Inquiry, 2013). As such, the application of Lean thinking during this tumultuous period in the NHS would be highly relevant and support several objectives healthcare organisations are trying to achieve.

In the UK, health care has a long history with service improvement (Department of Health, 2000; NHS Institute, 2008). Improvement methods in the late 1990s focused on the identification and resolution of problems in the existing workforce (Bevan et al., 2003). Public sector organisations typically focused on using business process improvement methodologies, particularly Lean and Six Sigma (Radnor and Boaden, 2008). The latter are favored by healthcare services, with Lean being increasingly applied with the aim of improving quality of care, safety, eliminate delays and reduce length of stay without using additional resources (Westwood et al., 2006; Silvester et al., 2004; Breyfogle and Salveker, 2004).

1.4 How is Lean applied in the NHS?

Despite its success in the manufacturing sector, transferring Lean to other industries has resulted in varying degrees of success. Research has shown that successful Lean implementation is strongly linked with

its adaptability to fit a particular setting. Lean is environmentally dependent and can generate benefits only when appropriately applied. It has been demonstrated that Lean is not directly applicable to every process, but instead needs to be transformed and tailored to fit a particular environment (Bamford, 2011). Therefore, being able to mould Lean to fit a specific healthcare context is essential in achieving the desired outcome. Some work has already been done on this with the NHS Institute for Improvement and Innovation (NHS Institute, 2007) adapting the Lean wastes in the context of the healthcare sector as shown in Table 1 (Radnor, 2011).

Typical Wastes in Services	Examples of Healthcare Wastes
<p><i>Transportation</i> Customers delayed by waiting for service, delivery, queuing, waiting for response, not arriving as promised.</p>	<ul style="list-style-type: none"> • Staff walking to the other end of a ward to pick up notes/ equipment • Central equipment stores instead of items located where they are needed
<p><i>Inventory/ Duplication</i> Having to re-enter data, repeat details on forms, copying information, answering the same query multiple times.</p>	<ul style="list-style-type: none"> • Unused, surplus stock in storerooms • Patients waiting to be discharged • Waiting lists
<p><i>Motion</i> Unnecessary movement: Queuing several times, lack of one-stop, poor ergonomics in the service encounter.</p>	<ul style="list-style-type: none"> • Looking for paperwork, e.g. drug sheets not in the correct place • Storing equipment at opposite ends of the room • Not having basic equipment available in every examination room

Table 1: The seven service and healthcare wastes. Adapted from Papalexi et al (2013a)

Typical Wastes in Services	Examples of Healthcare Wastes
<p><i>Waiting (Delays)</i> Unclear Communication and wastes from seeking clarification; confusion over product or service use, wasting time finding a location that may result in misuse or duplication.</p>	<ul style="list-style-type: none"> • Waiting for patients, theatre staff, doctors, results, prescriptions and medicines to arrive for process/procedures to begin.
<p><i>Over-production</i> Incorrect Inventory: Out-of-stock, unable to get exactly what was required, supply of substitute products or services.</p>	<ul style="list-style-type: none"> • Requesting unnecessary tests • Retaining investigation slots/beds 'just in case'
<p><i>Over or inappropriate processing</i> Lost opportunity to retain or win customers, failure to establish rapport, ignoring customers, unfriendliness and rudeness.</p>	<ul style="list-style-type: none"> • Duplication of information, such as asking for patients' details several times • Repeated clerking of patients
<p><i>Defects</i> Errors in the service transaction, defects in the product/service bundle, lost or damaged goods.</p>	<p>Corrections due to:</p> <ul style="list-style-type: none"> • Readmission due to failed discharge, adverse drug reactions • Repeating tests due to incorrect information

Table 1 (cont'd): The seven service and healthcare wastes.
Adapted from Papalexio et al (2013a)

1.5 Comparison with other countries

Despite Lean thinking in healthcare being a recent phenomenon compared to its application in the industrial sector (Fillingham, 2007; Institute for Healthcare Improvement, 2005), there are numerous examples of Lean interventions in hospital settings within the UK and the USA. There are also differences in the way that Lean has been put into practice within the two countries which we could learn from.

Research suggests that Lean implementation is not consistent between the two geographical areas (Papalexi et al., 2013b). The USA for instance, appears to have more experience than the UK. Brandao de Souza (2009) showed that more interventions have occurred in the USA (57%), compared with 29% in the UK but growing at a fast pace. The majority of UK Lean healthcare schemes were applied to clinical processes (73%), with the remaining 27% applied to support processes. In the USA, more emphasis was placed on improving support services with clinical processes accounting for 60%. This would suggest that UK health organisations have a stronger interest in improving the patient experience from their first contact with the healthcare system, whilst in the USA more prominence was given on the delivery of higher quality healthcare services.

There were similarities in the tools that were being used at the beginning of a Lean intervention and these were:

- Process standardisation
- Value Stream Mapping (VSM)
- PDSA cycles

Additional tools were used by both countries and this is when differences could be observed (see Table 2).

Context	Lean tools
UK	Standardisation, Value Stream Mapping (VSM), Plan-Do-Study-Act (PDSA) cycles, Kaizen event, Closed-Loop Management System (CLMS), Kanban
US	Standardisation, Value Stream Mapping (VSM), Plan-Do-Study-Act (PDSA) cycles, 5S, Six Sigma, Left-to-Right flow, Total Quality Management (TQM), SEM analysis, Benchmarking, Brainstorming, ABC analysis, Cause-and-Effect matrix

Table 2: Lean tools typically used by USA and UK healthcare organisations. Adapted from Papalexi et al (2013b)

It would seem that in the UK, the focus is on using Lean to improve flow, which was associated with improving the patient experience. On the other hand, US healthcare organisations focus more on increasing service quality through using six-sigma techniques.

Despite US healthcare organisations appearing to have more examples of Lean application, this does not necessarily mean that they are more advanced in becoming completely Lean. As mentioned earlier, Lean implementation requires commitment from the whole organisation and whilst case studies can demonstrate Lean in a single department, they can also be used as an indicator of the 'Leanness' of the organisation as a whole. This can be useful at a strategic level when reflecting upon the progress of one's Lean programme.

1.6 Levels of Lean implementation in healthcare organisations

There are four levels which can be used to describe an organisation's degree of Lean implementation; Education, Pilot Project, Modified and Total.

Research carried out by Papalexi et al (2013) classified the levels of US and UK Lean healthcare schemes using Safeyni's (1991) Lean Maturity Model. The results were as follows:

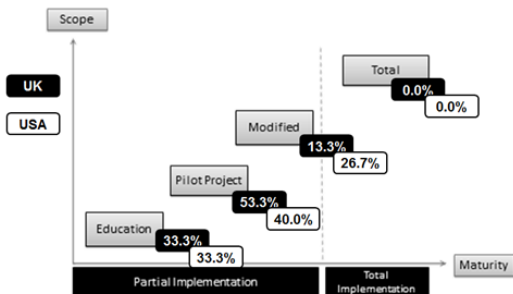


Figure 1: Lean Maturity Model. Adapted from Safayeni et al., (1991) and modified by Papalexi et al., (2013b)

The majority of Lean schemes in both countries were at the Pilot level, and there are similar proportions of Lean interventions at the Education level. The USA is more advanced in terms of the maturity of their Lean healthcare schemes, with 26% classified at the Modified level – double that of the UK. This implies that US healthcare organisations have greater experience or longer history with Lean to account for the higher maturity levels (Brandao de Souza, 2009).

Nevertheless, no case study was found where a healthcare organisation fell into the Total Implementation category, which highlighted the relative infancy of Lean application in the healthcare industry. However, the Royal Bolton NHS Foundation Trust in the UK is considered the closest healthcare organisation to achieving Total Implementation level (Radnor, 2010).

Lean Maturity Levels

Education Level

An intervention with the primary aim of finding a quick solution to a problem without understanding its root causes.

Pilot Level

These schemes show a deeper knowledge of the root cause of problems.

Modified Level

Interventions have successfully changed the operations of the organisation.

Total Implementation

Suggests that a world-class level has been reached.

Reflection Questions

Q: What types of waste can you find in your processes?

Q: What Lean characteristics does your organisation show?

Q: What is your organisation doing to measure the effectiveness of your Lean schemes?

Q: How mature is your organisation in Lean implementation?

Q: What do you need to do to progress to the next stage?

Chapter 2

Lean Thinking Applied

The NHS is undergoing significant change and transformation as it strives to make productivity savings whilst simultaneously improving levels of patient safety and quality of care. The previous chapter gave an introduction and overview of Lean concepts and this chapter will demonstrate how Lean thinking can be practically applied. It will describe the Lean approaches used in a service improvement project which was part of a NHS Trust wide transformation programme, as well as several case studies demonstrating the use of Lean on a strategic level. Challenges and lessons learnt are also presented.

2 Lean in Service Transformation

A healthcare Transformation programme can cover an organisation with thousands of staff members, hundreds of premises, and tens of different kinds of services. All of these are reviewed simultaneously – not necessarily in the same pace and order.

Throughout 2013, South West Yorkshire Partnership NHS Trust (SWYPFT) embarked on a Transformation programme in response to the UK healthcare productivity challenges. Within the Transformation programme was a series of service improvement projects which focussed on specific aspects of the care pathway and which used Lean thinking to redesign services. One such project was a review of the service access provisions across the Trust; namely, the four Single Point of Access teams (SPA). The project presented here is the ESRC funded Lean in Healthcare project (ES/K000667/1).

2.1 Improving access to healthcare

The organisational structure of the Trust has meant that service delivery was devolved into four Business Delivery Units (BDUs), resulting in the establishment of four autonomous SPA teams. It led to differences in operational processes between the teams, resulting in perceptions of inconsistent levels of service quality and performance across

What is SPA?
SPA is a gateway for patients into health services. A clinical decision making function that signposts referral to the best service team for the patient.

the Trust. The project used Lean tools and techniques to:

1. Establish a baseline of current SPA provisions across the Trust.
2. Develop improvement opportunities by identifying waste and constructing ways to remove/reduce their impacts.

The work was not done in isolation by the project manager. As is typical with Lean, a bottom up approach was used with direct engagement with frontline SPA staff and other relevant stakeholders when appropriate.

Box 4: Engaging with the workforce

A series of workforce engagement events were held throughout the project and these took the form of facilitated workshops. The workshops had several purposes:

1. Introduce frontline workers in the use of different Lean tools and techniques as the project progressed
2. Establish and reinforce the sense of ownership and inclusion
3. Information and data collection
4. Improve inter-team relationships and serve as a forum for in-house knowledge exchange and internal benchmarking

In addition to this, an in-house SharePoint was also created for information sharing and communication, with the workforce actively encouraged participating in virtual discussions.

Lean tools used

Each of the SPA teams had been developed differently in terms of their service scope, technological and staff resources, and operational procedures. In order to capture their differences, frontline workers from each team were directly engaged to understand these variations, and to collect relevant information and data. Value Stream Mapping (VSM) was used to capture the current state of each SPA team, highlight wastes and allow comparison to identify the variations between the teams. This led to the following realisations which also informed the next set of Lean approaches to use (as shown in Figure 2).

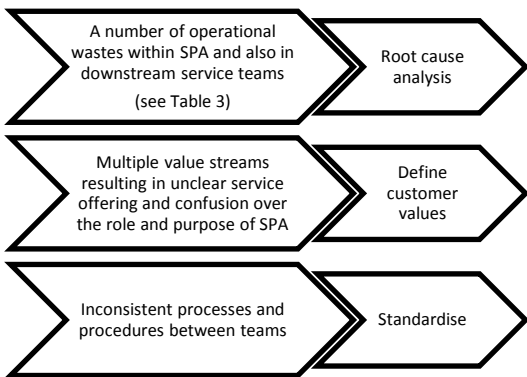


Figure 2: Realisations from Value Stream Mapping and subsequent Lean approaches

SPA	Service Teams
Waste type: Duplication	
<ul style="list-style-type: none"> • Checking completeness of all referrals • Request additional information if necessary • Converting referral information into electronic format 	<ul style="list-style-type: none"> • Some teams have set up their own screening process to screen the suitability of incoming patients • Re-signposting patients to a more appropriate team
Waste type: Waiting	
<ul style="list-style-type: none"> • Responsiveness of GPs to supply additional information varies from a few minutes to days which delays the processing of the referral as clinical decision making can't take place 	
Waste type: Defect/Error	
<ul style="list-style-type: none"> • When patients are signposted to the wrong service teams because SPA signposted based on inaccurate/incomplete referral information 	
Waste type: Inappropriate processing	
<ul style="list-style-type: none"> • When service teams begin treatment of a patient before realising the service isn't appropriate for them 	

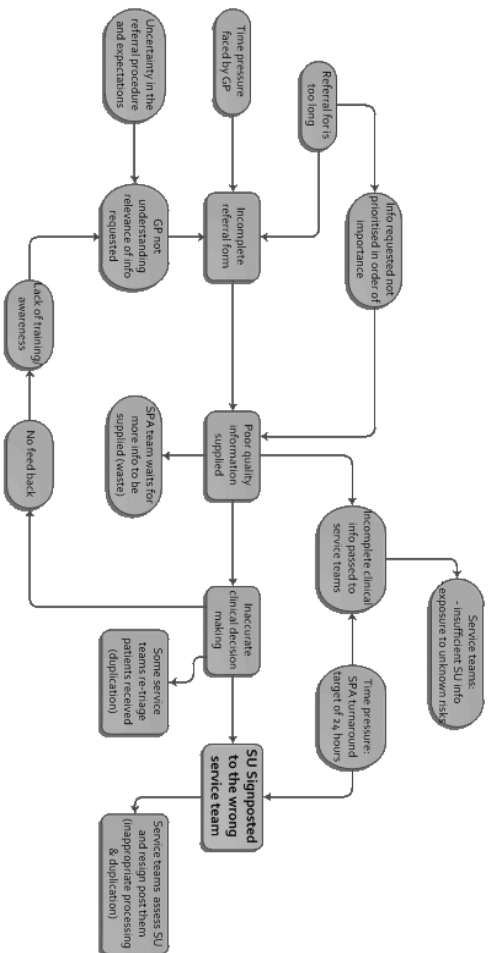
Table 3: Wastes identified in the SPA referral process

By using Root Cause Analysis and through the use of a Linkage diagram (Figure 3), the origins of the following wastes were traced back to the way referral information was being supplied to the SPAs:

- Inaccurate signposting causing downstream duplication (assessments and re-signposting).
- Missing or poor quality referral information.
- Waiting for additional referral information.
- Duplication: converting paper referral information into electronic format.

This was reinforced when engagement with SPA's main customers, GPs, confirmed that the main source of their complaints was the five page form they were required to complete when making a referral. Further engagement with GPs defined a set of customer values to consolidate the multiple value streams and to reinforce the role and purpose of SPA. These customer values, combined with the results of the root cause analysis were subsequently used to develop service redesign solutions that aimed to eliminate wastes and also fulfil the needs of the customer.

Figure 3: Root cause analysis for incorrectly signposting service users



The House of Quality (HoQ) framework (typically associated with Quality Function Deployment, QFD), was used to assess the SPA redesign options to identify which would best satisfy the needs of the customer. The results of the HOQ are shown in Table 4. It determined that Option 4 or 5 would best satisfy the GP values. There was only a 1 point difference between these two solutions with Option 5 - Combination of telephone & electronic referral system, scoring the highest and therefore the preferred option.

Redesign Options	HoQ Score	Ranking
1. Do nothing but roll out planned RiO IT document scanning	30	5
2. Referral form submitted via email	44	4
3. Online referral form integrated into RiO IT system	48	3
4. All referrals taken by telephone	60	2
5. Combination: Telephone & electronic submission	61	1

Table 4: Results of the House of Quality to identify preferred redesign option

Outcomes

The preferred solution was to replace the paper referral form with an optional telephone based and electronic referral submission system. The use of a telephone based referral system would allow the SPA clinician to 'pull' relevant referral information to inform their clinical decision making and ensure the referral information is complete. It would also create stronger

links between primary and secondary care clinicians. Both GPs and SPA Clinicians considered telephone conversations to be valuable in creating richer clinical discussions and improved information exchange – particularly in conveying urgency, as well as serving as a knowledge transfer mechanism, i.e. instant feedback and education when referrals aren't suitable for services.

In addition, the following process wastes would be mitigated:

- Reduce signposting errors, i.e. improved quality of referral information to facilitate SPA clinical decision making.
- Eliminate waiting for additional referral information from referrers. This can range from a few minutes up to several days.
- Reduce number of inappropriate referrals made to SPA which was around 5%.
- Reduce GP waiting times for advice/consultation from service teams/specialists.
- Remove duplication from converting paper referrals into electronic format. Typing up a referral form into the IT system takes approximately 20 minutes per referral. This equates to around 3,950 hours per year.

2.2 Reducing variations in the clinical decision making process

Through the SPA project, it was recognised that one of the potential root causes of service users being signposted to an inappropriate service team was due to human/clinical decision making error. This resulted in wastes such as longer cycles times, inefficient resource utilisation, service quality problems and

duplicate assessments further down the care pathway. Interviews with frontline workers revealed that the signposting decision was relatively subjective and at the discretion of individual SPA clinicians.

Additional interviews and engagement with service teams revealed tensions between SPA and several teams which centred on the incorrect signposting of service users. This led to negative perceptions of the SPA teams within the organisation, yet highlighted the fact that the causes of the SPA signposting errors were not fully understood. Anecdotal evidence suggested insufficient training amongst SPA staff, weak management, not interpreting referral information effectively and by far the most compelling reason, gaps in the Trust's service offering.

Box 5: A Gap in the Service Offering?

Interviews with SPA workers and representatives from service teams revealed interface issues and tension between SPA and several service teams. These service teams claimed that they were sent a high number of service users whose needs were probably best suited in an alternate service. The impacts of SPA inaccurately signposting referrals were the creation of a number of problems:

- Unnecessary multiple assessments for service user
- Re-directing service user to more suitable service
- Service user delayed in receiving treatment
- Potential of exposing staff to high risk individuals

There was consensus that SPA was effective in triaging between Crisis and Routine referrals. However, there was a belief that SPA had difficulties in distinguishing the treatment pathways for Routine referrals; in particular, when service users should be signposted to Improving Access to Psychological Therapies (IAPT) and Community Mental Health Team (CMHT).

It was thought that there was an ambiguous group of service user whose needs were too severe to be treated by IAPT, yet not severe enough to deal with by CMHT resulting in service users being 'bounced' between these two teams. It was believed that there was a gap in the Trust's service offering between the IAPT and CMHT services which was causing the majority of the signposting inaccuracies in SPA.

Analysis of data suggested that the signposting error rate ranged from 17% to 55%. The investigation also revealed that the majority of signposting errors were in fact between SPA and **three** different service teams; IAPT, CMHT and Adult Psychological Therapies (APT). This was extremely useful because it disproved the managers' original perception that there was a gap in the Trust's service offerings between IAPT and CMHT. This avoided the creation and introduction of a potentially unnecessary service. The analysis of the data helped people to get an accurate picture of what was really happening and to understand where the problems were arising in order to work towards a proper solution. In this instance, the data implied difficulties in how SPA distinguished between referrals suited to IAPT, CMHT and APT. As such, the root cause of the signposting problems appeared to be inconsistency in the clinical decision making process. Therefore, the process through which the SPA clinician formulated their signposting decision was investigated to further understand the problem.

Through the investigation it was also revealed that there was no formal monitoring mechanism to record the accuracy of SPA signposting. It was also recognised that there was an absence of a 'check' or feedback mechanism that would allow the SPA teams to monitor their clinical decision making effectiveness, in particular how well they were signposting service users to the right service team. It also revealed that no formal 'forum' existed to allow SPA and Service Teams to discuss service users who had not been correctly signposted,. This meant that lessons were not learnt when mistakes were made, thus further aggravating the relationship between SPA and service teams.

SPA Clinical Decision Making Process

As revealed in the Box 5 case study, the SPA signposting problems appeared to stem from inconsistencies in the clinical decision making process which required further investigation. Interviews with SPA Clinicians found that they considered a number of factors during their clinical decision making process. Three of these were qualitative factors such as the Sainsbury risk assessment tool, patient history and the current risk level of the patient. These were combined with the results of two quantitative surveys (PHQ-9 and GAD7). Nevertheless, the clinical decision ultimately rested solely on the expert opinion of the individual SPA clinician (Dehe, 2013). Further investigation revealed that variations existed between individual clinicians due to their levels of experience, risk perception, training and knowledge of available services; all of which could affect their clinical decision-making process. With such high degrees of variations, the application of Multiple Criteria Decision Analysis (MCDA) was considered ideal.

How could MCDA be applied?

1. Develop a common model with input from the four SPA teams to gain consensus on which criteria should be taken into account.
2. Develop and assign a weighting to each criteria.
3. Pilot the model using historical patient case data and adapt to improve the accuracy of the model.
4. Refine the MDCA model as appropriate and implement as part of the service redesign.

What is MCDA?

Multiple Criteria Decision Analysis (MCDA), is a method and framework to cope with the multiple aspects of a situation. It allows the aggregation and weighting of both qualitative and quantitative data to optimise decision making.

The use of MCDA is useful to support a more consistent approach to clinical decision making. An MCDA model can offer a powerful, structured framework to support the information exchange between clinicians by integrating qualitative and quantitative data within the same model in a systematic and consistent manner. It can help consolidate the information asymmetries between clinicians and has the necessary validity to be applied to the SPA process.

Box 6: The SPA MCDA Model

A bespoke MCDA model was developed based on the results of in-depth interviews with SPA Clinicians. The decision making process and the criteria the SPA Clinician typically considered are summarised below:

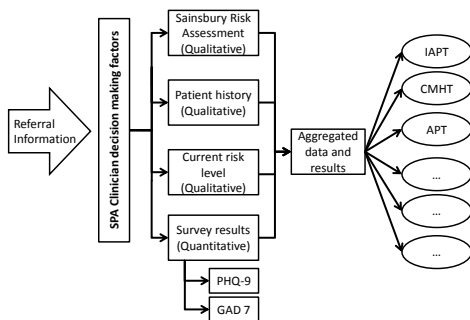


Figure 4: SPA Clinician referral signposting decision making process. Adapted from Dehe (2013).

The decision making process was based on information supplied to the SPA Clinician on the referral form.

The information is a mixture of qualitative and quantitative factors which the clinician used in conjunction with their knowledge and experience to assess and determine the most appropriate service team to signpost the referral. The resulting signposting decision was therefore heavily subjective and at the discretion of individual clinicians based on individual levels of experience and expertise.

The MCDA model offered a methodology and framework to cope with the multiple aspects behind the signposting decision. In doing so, it can rationalise, standardise and bring consistency to the decision making process. MCDA works by allocating a weight to each criterion depending on its importance in informing decision making and the results aggregated to generate a score. The score can be used to distinguish which service team would be the optimal choice for a specific referral. The purpose of the SPA MCDA was to offer clarity to the SPA Clinician in distinguishing which service users would be best suited to IAPT, APT and CMHT.

It was recognised that the distinguishing factor between these teams was the level of risk. As has been demonstrated earlier, assessing risk of a referral is a key component of the SPA clinical decision making process and risk perception can vary between individual clinicians due to its qualitative nature. Developing a bespoke MCDA model for SPA could potentially quantify 'risk', to support/reinforce their decision making and help bring consistency in how risk is perceived between clinicians.

A prototype MCDA model developed by the project team showed promising results in being able to distinguish between service user groups. With greater refinement of the criteria weightings and testing using real life historical cases, there is great potential for a bespoke MCDA model to support and improve the accuracy of clinical decision making within SPA.

3 Strategic Applications of Lean

The following sets of projects illustrate how Lean can be applied on a more strategic level to influence and improve the decision making process – in particular, the development of future healthcare resources and cultivating closer partnership working. It highlights how the implementation and dissemination of appropriate models can support complex and transparent decision making to resolve some of the issues that the NHS faces. The three projects presented are KTP collaborations with NHS Bradford and Airedale (KTP 1717, 7352, 7698).

3.1 Redesigning healthcare logistics

The project looked at both patient transport and logistics provisions that moved services and resources around the Bradford area. It involved an assessment of existing provisions, application of Lean thinking theories to rationalise the Trust's logistical assets, and offered recommendations for redesign.

The presence of a robust transport system has been found to improve access to healthcare services, yet it is often a forgotten element. This was supported by frequent comments arising from public consultations that transport is key to being able to access health services. The Department of Health social exclusion unit estimated that 1.4 million people per year missed/turned down or choose not to seek healthcare appointments because of transport issues (Department of Health, 2006). Therefore, improvements to the Trust's transport and logistic

system could make a strategic contribution, allowing more patients to access healthcare services.

The NHS approach to transport service provision was traditionally separated into patient and non-patient services. These were focused on individual efficiencies rather than overall system effectiveness. Because transport provisions were fragmented, there was lack of understanding of the different aspects and their associated costs. As more services shifted from acute settings and into the community, greater demand was being placed on transport provisions and the need for a more integrated approach between care providers in the district.

Patients notes have to follow the patient throughout their care pathway so when a patient is treated in the community, their notes from the acute services need to be there too. In addition, it was found that pathology services were only provided in the acute setting; therefore, all specimens taken in primary care have to be routed to secondary (acute) care for testing. These samples can be taken 24 hours a day and have a 'shelf life'. This places a huge demand and pressure on the transport infrastructure (Bamford et al., 2009). The Trust uncovered the use of a number of transport providers for this service who all worked in isolation of one another. Transport-related logistics service expenditure across the Trust was estimated be in excess of £400,000 per annum – much of which was spent in an ad hoc manner (for example, of medical supplies, devices, aids and adaptations, and so on) which was not centrally coordinated and not managed in terms of efficiency or effectiveness.

The project brought together the various transport and service providers, who were able to uncover significant duplication, especially in the movement of

specimens and patient notes throughout the system. This enabled a new model to be developed that would reduce the duplication and ultimately reduce costs to each organisation. Due to the complexity of the associated logistics, an integrated service improvement approach was used that involved four healthcare organisations – the Primary Care Trust, Acute Trusts and the Ambulance Trust.

Outcomes:

The outputs of the project saw the creation and roll out of an Integrated Transport Unit (ITU) in collaboration with other trusts and the local authority. This resulted in a patient transport unit which co-ordinated and centralised some of the decision making. The approach not only radically improved the situation but also reduced a host of non-value-added activities. Examples included reducing spend on ad hoc and non-contracted taxi journeys, more efficient use of staff time (by reducing time spent on organising transport), better and more appropriate in-house vehicle fleet usage, and consolidating van runs.

In doing so, this project was successful in terms of achieving both process improvement and efficiency through optimisation which were quantifiable and actually evidence based. By redesigning and optimising NHS Bradford and Airedale's transport system and logistical assets management, the Trust was able to save in excess of £280,000 per year. A number of other indirect benefits were also realised (Bamford, 2013) such as:

- *Improved ambulance response times* by reducing inappropriate demand placed on ambulance vehicles and reserving them for “real emergencies”.

- *Reduction in DNAs* - people were less likely to waste an appointment if they can get there or if it is easier for them.
- *Contribute to reduce health inequalities and work towards health prevention* - if people could access service better, then they could receive both early intervention and preventative care.

3.2 Aligning the strategic needs of healthcare commissioners and providers

This project focussed on how to inform strategic decision making by using classic management theory and evidence based. It involved the use of performance appraisals and the balance scorecard frameworks to convert data sets into information in a business context, whilst integrating the fundamental purpose and aim of the Trusts; to provide appropriate patient services. It was about looking after the health of the local population.

The implementation of the Balanced Scorecard (BSC) enabled NHS Bradford and Airedale to align its strategies from its different units, and have a more robust and comprehensive approach to strategy deployment. It has helped the Trust to improve the effectiveness of its strategic decision making. It also established the use of formal decision making methods within healthcare at a time when it wasn't practised as regularly as perhaps it is today. The introduction of the BSC and other strategic tools significantly improved the strategy alignment between the different units, as well as between the commissioning and provider arms.

3.3 Reducing the cycle time of healthcare infrastructure projects

In this project, Lean construction concepts and decision making models were applied during the planning, design and management cycle of healthcare infrastructure projects. The Trust was in the process of assessing and developing new healthcare facilities that would satisfy current and future service demands. Existing premises were considered not fit for purpose to fulfil the Trust's strategic aims and objectives. Furthermore, it was recognised that there was a lack of mechanisms, systems and procedures for overseeing the development and delivery of new healthcare premises and ensuring that they were suitable.

The Infrastructure Development Cycle

The infrastructure development cycle describes the major steps and milestones common to all new premises development projects. The four phases are:

1. *Planning* – alignment with operations strategy and shaping of the network and future development.
2. *Design* – recognising the design processes/needs of both infrastructure and the services.
Synchronising the two sets of design needs is essential to maximising fitness for purpose.
3. *Construction* – typically outsourced to contractors to deliver the physical product, and associated with funding and handover processes.
4. *Management* – associated with soft facilities management techniques, as well as opportunity to embed culture of continuous improvement and develop performance measures and monitoring systems.

➤ *Evaluating and optimising the decision making process of new healthcare centres*

In the Planning phase, estates rationalisation and site selection were identified as real issues and bottlenecks within the infrastructure development process. The problem appeared to be balancing and satisfying the needs of various stakeholder groups; in particular, the local populations who had a high interest and genuine concern over the location of their future healthcare centre, with the local political issues and strategic direction of the Trust. However, it was recognised that without a decision on the location of the new premises, the ability to carry out other planning and design activities were hindered. It also ultimately resulted in a longer infrastructure development cycle time (up to 15 years), and developments which might not necessarily be fit for purpose.

With decision making within the planning and design stages understood to be the process bottleneck, any effort to improve the overall development should be focussed on alleviating these constraints. As such, the following tools and techniques were applied:

- i) MCDA to optimise the site selection process.
- ii) A performance framework to support the innovation and continuous improvement.
- iii) QFD to optimise the design decisions.

They formed the bespoke Lean methodology deployed to support the new infrastructure development processes.

MCDA methods were used to evaluate and assess the potential locations of future healthcare centres, strategy options and assisted in supplier selections. It

involved looking at a number of criteria and associated sub-criteria. The criteria included:

- Environment and safety
- Population profile
- Total cost
- Accessibility
- Risks
- Design

The weighting for each criterion was informed by outputs from the public and stakeholder consultation events. This allowed the creation of a model that applied evidential reasoning to identify an optimum site location. The MCDA was not restricted for use in site selection, but could be used to inform other strategic decisions. By using MCDA, it was established that the cycle time for the Planning phase could be reduced from 50 months to 36 months – a 28% cycle time reduction.

➤ *Using the voice of the customer to drive infrastructure design*

During the Design phase, it was established that using an iterative process such as Quality Function Deployment (QFD) could support design decision making. QFD combined the service needs and infrastructure needs to generate design solutions that would be fit for purpose in terms of satisfying both sets of requirements. It allowed the design team to focus on what internal and external customers valued the most and considered critical to drive the design process. QFD is based around a standard framework known as the House of Quality that was used to transform the requirements of the patients and local communities into both service and building quality design. These requirements were collected through interviews, questionnaires, focus groups, patient feedback and complaints; analysed and fed into the framework.

The QFD models facilitated information sharing, controlled processes and ensured transparent decision-making based on Lean thinking principles (waste elimination, focus on value added activities and setting-up for continuous improvement). In implementing the QFD framework, a number of benefits could be achieved, most notably:

- A 15% reduction in design iterations.
- 10% improvement in the speed of the Design phase.
- Reducing the Design phase from 27 months to 22 months.

Through partial and bespoke Lean implementation the Trust was able to reduce the overall infrastructure development cycle time by 18% and reduce costs by 7.35%. Furthermore, the project improved both the fitness for purpose and incorporated aspects of innovation integration and engagement activities. The overall impact of this project is the generation of approximately £1.5 million in cost savings for the Trust.

4 Challenges to Lean in Healthcare

Although the Lean projects presented in this chapter have illustrated numerous benefits, the route through which they were achieved was not without challenges. Research has shown that 70% of change projects fail to achieve their main objectives, whilst 90-95% of Lean initiatives fail (Bamford et al, 2003). With this in mind, this next section offers practitioner reflections and lessons learnt from a service transformation project, as well as some tips on how to become more resilient for future Lean projects.

If things go wrong, remember:

- You did your best so this will make accepting failure easier
- Learn from it – take time to reflect; after all, you have gained an experience!
- The idea didn't fail, its execution did. Redevelop and improve it so next time it will be more successful
- Create a culture of accepting honest failure by sharing your learnings
- Accept it has happened... and move on.

➤ *The organisational culture isn't ready for change*
An important aspect of Lean implementation is a change in the organisational culture; moving away from traditional top down management to a bottom up approach and entrusting and empowering the workforce to deliver change. However, there are some who have experienced uncertainty and fear amongst the workforce which resulted in resistance and unwillingness to engage and support Lean schemes.

It was thought that lack of communication, transparency and low visibility/absence from senior management confounded the problem. It is therefore important to realise that Lean cannot simply focus on improving the operational process, but must also include organisational change management.

➤ *Maintaining strategic buy-in and momentum*

As a Trust undergoes a period of quite intense change, it can be particularly challenging to maintain focus and momentum. Particularly when new ideas are being generated but not enough time is spent on developing them and seeing them through to the end.

Changes in leadership and changes in who holds ownership of the programme can present an additional challenge. This reinforces the importance of assigning clearly defined roles and responsibilities in these types of projects for the purpose of managing expectations. Furthermore, the role of leadership is pivotal in driving a project forward; dictating the pace of change to ensure that it isn't too slow so the workforce loses interest, nor too fast to avoid good ideas being applied badly.

➤ *Availability of data*

Another significant challenge was data availability. Some clinical data can be easily available and of reasonable quality and then there is data that is unobtainable or simply does not exist. The latter can cause delays in the project. It highlights the need to be really clear about data requirements prior to the start of a project and to initiate discussions with the data owners so that they understand its importance, and what it will be used to achieve.

➤ *Unclear Lean programme/project plan*

An absent or poorly established programme management structure and plan can result in project delays. For example, if there are queries which require strategic input/guidance but the absence of a clear structure and hierarchy makes obtaining answers difficult. Nevertheless, it reinforces the importance of having clearly defined roles and responsibilities for all individuals involved right from the start.

Practitioner Reflections

When we went in to work with different staff groups doing process mapping and having discussions around improvements, there was singularly little resistance to change and lots of eagerness to do things better and more effectively. I think it is really important to trust the front line staff. They are very creative people, open to new ideas and often they are constantly on the lookout for better ways to do things. But, they need to be given permission to make the changes they need to make. I think this is where Lean can really support us because this is one of the fundamental principles of Lean; the people who are delivering the services, are the people who know what the problems are and who are best placed to work out the solutions to those problems.

- Lead Service Improvement and Development Manager

4.1 What can be done to overcome challenges?

Practitioner Reflections

- *Spend time at the beginning being really careful about how you set things up. Make sure that you understand the scope of what you are trying to do and that everybody else who is involved understands and agrees the scope.*
- *Make sure you are really clear about precisely what you are going to deliver, the different roles involved, the different responsibilities involved. Make sure that everybody agrees and understands them and are comfortable with them.*

The more time you spend on that, the less hassle you will have later on in the project!

- Lead Service Improvement and Development Manager

Here are some top tips for personal resilience:

- ✓ It is not a 'failure' but an 'opportunity to improve and learn'.
- ✓ Remember the good experiences: Get inspired by best practices and your achievements!
- ✓ Celebrate successful stories.
- ✓ Remember the positives: actively collect compliments – keep emails and letters of thanks from patients.

Reflection Questions

Q: What are you doing or what more could do to ensure your Lean schemes engages from the bottom up?

Q: How engaged are your senior management team in your Lean initiative?

Q: Q: What are you doing or what more could do to prepare your organisation for the upcoming change?

Q: What can you do to mitigate some of the challenges?

Chapter 3

Lean Thinking Dissemination

This Chapter outlines various methods and techniques that can be used to facilitate information and knowledge sharing, internally and externally. Having presented a series of Lean in healthcare projects in the previous chapters, the benefits are clear. Although these projects generated a number of benefits to the local environ, it is believed that sharing these learnings (and also your own) would have a far greater reach and impact. In particular, allowing other regional and national NHS Trusts, GPs, Clinical Commissioning Groups and the National Commissioning Board to improve their strategic processes, make further cost savings and ultimately bring major benefits to the NHS patients they serve.

5 The Importance of Dissemination

Although the idea of Lean applied within NHS processes is not new (Bamford et al., 2011; Boaden et al., 2008), the dissemination and further implementation of the knowledge and learnings gained from previous Lean projects is an equally important activity that could be better practiced.

Disseminating best practice and accumulated knowledge presents an opportunity for other organisations to challenge their status-quo, and encourage them to revise their existing processes, and work towards rationalising and optimising resources by using Lean thinking. If done effectively, its impact could potentially expand beyond inspiring colleagues and industry peers, to directly influencing policy makers through engaging with the wider health community.

There are a variety of proven tools and methods that can be used to disseminate work to the wider health community and these can be applied both internally and externally and some of these are presented in this chapter.

5.1 Create a dedicated project website

Establishing a website for a project can be useful way to share information, particularly for sharing greater quantities and more detailed information and resources in a readily available and cost effective manner (a lot faster and cheaper than mailing out brochures, leaflets, and other paper based items).

Furthermore, a website can host a variety of multimedia platforms that can make disseminating your work more interesting and engaging, e.g. Discussion boards, electronic surveys, podcasts, downloadable materials.

Ultimately, a project website can be used as a central source of information that is freely and permanently available to all those who wish to access it.

5.2 Use and expand your existing network of contacts

Dissemination and knowledge sharing typically begins by exploiting existing relationships. This could take the form of something simple like having a casual conversation with a colleague about the progress of the Lean project, or through more official means, such as project meetings, reports, posters, intranet site.

Making contact with people you already know and asking them to support your dissemination efforts is a very effective way to grow your own network of contacts and share your work. Other people endorsing your work gives it added credence and increases its prominence. This reinforces the importance of ensuring a Lean project is engaging within an organisation to maintain momentum and to some extent, ensure strategic buy-in; both of these were

SharePoint

There will be instances when information needs to be shared or communicated to a restricted audience, i.e. only to in-house/project staff. Using an internal virtual shared document storage area such as a 'SharePoint', in parallel to the website can facilitate this, as well as create transparency and sense of inclusion in a Lean project.

identified as challenges to Lean in healthcare projects in Chapter 2.

The external impact of increasing the visibility of a Lean project is its expansion beyond the confines of the host Trust to neighbouring Trusts and eventually further afield, and potentially policy and national strategy development level. There is also the potential of it reaching the realms of other institutions, e.g. Universities; nurturing partnerships working or improved links with these institutes for access to research and knowledge exchange. The development of these networks doesn't necessarily rest solely on the networking capabilities of a sole individual, but the effective use of other readily available tools can make network development much easier. One such example is social media.

5.3 Using social media

Advancement and availability of technology have allowed individuals and organisations to use more innovative methods to communicate and collaborate with each other, and one such example is Social Media (Williams et al., 2012). It has been used by many organisations, not only as tools for increasing communications with their customers but also for improving learning within their organisation (Huang, Yang, Huang, & Hsiao, 2010). According to McKinsey & Company, "69% of executives, that have implemented a social media strategy [...] have gained measurable business benefits, including better access to

What is Social Media?

Social media is, "a set of technologies and channels targeted at forming and enabling a potentially massive community of participants to productively collaborate" (Bradley, 2010, p.2).

knowledge and higher revenue” (Henneman, 2010, p. 4), so it can be relevant in sharing learnings from Lean projects.

Box 7: Case Study - @UoHLeanHealth

A Twitter feed was set up during the ‘Improving Access to Healthcare’ Lean project. Its purpose was to:

- Provide real time information on latest project activities and development
- Generate discussions and seek advice/guidance/opinions around Lean thinking from others
- Follow latest thinking and topics around aspects of Lean healthcare
- Access individuals who in normal circumstances may be difficult to contact

One of the benefits of Twitter is the two way interaction. Not only can you proactively develop your network by ‘following’ others, but it is passive as well; allowing others who have an interest in the project to seek you out and ‘follow’ directly. Within six months of starting the project feed, the account accumulated over 220 followers and helped raised awareness and sharing of findings and learnings from the project. Furthermore, by monitoring discussions taking place in the healthcare social media community, it enabled the identification of a relevant and ‘trending’ topic for a seminar event. This was subsequently identified as “Challenges to Healthcare Transformation” (see Box 8). Therefore, not only did the use of Twitter allow the real time sharing of project activities and ideas, it also played a central role in building a bespoke network of individuals with a shared interest in Lean healthcare to eventually deliver a seminar event that was appealing and of interest to the community.

Academic researchers have been using social media to communicate their work, finding out about others work, or for developing and sustaining networks (Rowlands et al., 2011). Feedback/responses are instantaneous and due to its web-based nature, geographical limitations no longer hinder discussions and knowledge exchange.

There are numerous types of social media platforms such as Blogs, Twitter, LinkedIn, YouTube, Facebook, Pinterest and Instagram; each appealing to different demographics and with a different tone. For example, LinkedIn targets the professional workforce to share industry specific news and to allow the user to connect to other similar individuals (LinkedIn, 2014). Therefore, it is important to have a clear understanding of the audience you intend to share with and the 'tone' and image you would like to project, as this would dictate which social media platform to use.

5.4 Host or attend industry seminar events

Organising a bespoke seminar event is an ideal way to share work and knowledge directly with a specific audience. It can be particularly effective in engaging practitioners to allow dissemination to a wider network of other NHS Trusts and healthcare organisations. Not only would a seminar help to expand your own network of contacts, but it will also allow attendees to develop their own networks and share their experiences with peers.

External organisations often organise their own seminar/conference events and typically place a ‘call for speakers’. These are ideal opportunities to proactively share a Lean project to relevant individuals involved in local/regional healthcare community. Higher education institutes may be keen to develop links with local industries so being available to share experiences of the practical realities of the application of theory would be of great interest to them. Other healthcare knowledge sharing networks include NHS National Institute of Health Research (NIHR), regional Collaboration for Leadership in Applied Health Research and Care (CLAHRC), Academic Health Science Networks (AHSN).

Box 8: Case Study - Challenges to Healthcare Transformation Seminar

The University of Huddersfield held a bespoke seminar event targeting healthcare practitioners. The event was open to all healthcare professionals and healthcare researchers. Delegates came from several NHS trusts, councils and third sector health service providers from across Yorkshire and as far as Greece.

The focus of the seminar was to share previous healthcare projects which had applied Lean thinking. This exposed attendees to the application of Lean in newer contexts, latest academic research into Lean healthcare, as well as providing an opportunity to network and exchange stories and experiences. As well as presentations from the University of Huddersfield and Manchester Business School, group discussions took place which saw delegates reflect on why change and Lean projects fail, and what they can do in the future to be more resilient. This seminar clearly demonstrates how an event of this sort can cultivate cross-functional knowledge transfer; where partner organisations can present projects and results to the NHS audience.

Box 9: Case Study - BOSCAT research group

The Business Operations, Supply Chain and Transport Research Group (BOSCAT), based at the Business School, University of Huddersfield meet every two months with each meeting based on a theme. Teaching staff, researchers, PhD students are invited to attend to watch presentations from fellow researchers and invited industry guest speakers. In November 2013, the topic for the meeting was Lean in Healthcare. This gave attendees a unique opportunity to experience academic and industry perspectives of the same topic, as well as enable them to make suggestions for improved ways of applying Lean and to challenge/debate current thinking.

5.5 Use multimedia differently

Whilst traditional dissemination mediums can be heavily text based, i.e. articles, websites, blogs; this may not appeal to everyone nor hold their attention. Using other methods that contain an element of interaction and that differ from the norm, can be more appealing and facilitate greater engagement. Examples are audio Podcasts, Video casts and the use of 'Prezi' instead of a standard PowerPoint presentation. Prezi differ in that it can contain greater amounts of information in different media formats (embedded videos, audios) yet allows the user to explore the information themselves; at their own pace, in the order they want and level of detail they need. The zooming feature of Prezi can make exploration more visually appealing and engaging, rather than clicking through a traditional slide deck.

5.6 Apply for awards

Finally, consciously celebrate success and simultaneously increase awareness of your Lean

projects by applying for industry and/or in-house awards. Even if the application is unsuccessful, at least it would have reached the attention of those assessing it. Nevertheless, if the project wins than your efforts and achievements will be recognised, and your learnings shared.

Reflection Questions

Q: What Lean projects have you done that you could share with others? Remember, they don't have to have gone to plan and don't just share the results, share your experience.

Q: What have you done to share your Lean thinking projects?

Q: What networks or organisations can you get involved with to expand your network?

Q: Do you have the relevant skills/resources to disseminate effectively? What might you need?

Concluding Remarks

As this book has showcased, Lean is highly relevant and applicable to the NHS and can support and underpin the significant changes that are taking place. The case studies have shown that the correct adaptation and application of Lean can help healthcare organisations gain better insight into their ways of working and to challenge them accordingly.

It is also important to recognise that not all Lean projects go according to plan, so practitioners need to develop resilience. Furthermore, taking time to reflect – an often ignored aspect of project management, will reinforce and improve the chances of future success.

Despite the many success stories of Lean healthcare projects, the sharing and disseminations of key learning is relatively under practised. However, it must be recognised that dissemination can significantly increase the impact of your Lean project (successful or not) as it allows others to learn from your experiences and vice versa, and expand its influence beyond the local environ to the wider healthcare industry.

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Glossary of Terms

5S

A method that optimises a workspace to improve worker's efficiency and effectiveness based on five principles:

- *Sort*: eliminate what is not needed
- *Set in order*: arrange the remaining items in a tidy, orderly manner with designated places to allow quick and easy access
- *Shine*: ensure the surrounding areas are kept clean and inspect regularly
- *Standardise*: set standards and establish routines to maintain cleanliness
- *Sustain*: follow the procedures above and continuously improve them

A3

A3 thinking is a methodical approach to problem solving. It is based around a one page A3 report that; 1) records a problem, 2) reviews and analyses the current state, 3) develop a future state, 4) action plan.

Balanced Scorecard

A performance measurement framework that supports strategic planning and management. It combines strategic non-financial performance measures to traditional financial metrics to give managers and executives a more 'balanced' view of organisational performance.

Benchmarking

Finding, adapting and using ideas and strategies from outside the organisation and industry to improve performance.

Bottleneck Analysis

Identifies which part of the process limits the overall throughput so that efforts are focused on improving the performance of that part of the process.

Gemba (The real place)

A philosophy that reminds us to get out of the office and spend time on the shop floor/front line – the place where the real action occurs.

Just in Time (JIT)

Pulls parts through production based on customer demand instead of pushing parts through based on projected demand.

Kaizen

A strategy where employees work together proactively to achieve regular, incremental improvements.

Kanban (Pull)

A method of regulating the flow of goods both within the factory and with outside suppliers and customers. Based on automatic replenishment through signal cards that indicate when more goods are needed.

Theory of Constraint (TOC)

Introduced in 1984 by Eli Goldratt in his book, “The Goal”, the core concept of the Theory of Constraints is that every process has a single constraint and that the total process throughput can only be improved when the constraint is improved. TOC seeks to provide precise and sustained focus on improving the current constraint until it no longer limits throughput, at which point the focus moves to the next constraint.

Quality Function Deployment (QFD)

QFD transforms and prioritises the customer needs into characteristics for a product or service. It is an

integrated method that uses the Voice of the Customers (VOC) to inform and drive the design, creation/manufacture and delivery of products and services.

Value Stream Mapping

A tool used to visually map the flow of production. Shows the current and future state of processes in a way that highlights waste and opportunities for improvement.

Pareto Analysis

Used to help prioritise problems to address by highlighting the fact that most quality problems stem from a small number of causes, i.e. 80% of rejects are caused by 20% of defect types.

Plan Do Study Act (PDSA) Cycle

An iterative methodology for implementing improvements:

- Plan (establish plan and expected results)
- Do (implement plan)
- Study (verify expected results achieved)
- Act (review and assess; do it again)

Root Cause Analysis

A problem solving method that focuses on resolving the underlying problem instead of applying quick fixes that only treat immediate symptoms of the problem. A common approach is to ask 'Why?' five times.

Six Sigma

Six Sigma seeks to improve the quality of process outputs by identifying and removing the causes of defects (errors) and minimising variability in manufacturing and business processes. It uses the DMAIC (Define, Measure, Analyse, Improve, Control)

framework and statistical tools to uncover root causes to understand and reduce variation. A six sigma process is one in which 99.99966% of the products manufactured are expected to be free of defects.

Statistical Process Control (SPC)

It is a practical statistical approach to resolving problems. SPC is a tool that can be used to understand the scale of any problem (the degree of variation) and identify possible causes when used with other investigative tools e.g. process mapping, spaghetti diagram. A more efficient system can only be achieved by reducing and controlling these variations.

Additional Resources

**Lean in Healthcare, University of Huddersfield
BOSCAT**

www.hud.ac.uk/research/researchcentres/boscat/leanhealthcare

Institute for Healthcare Improvement (IHI)

www.ihl.org

NHS National Institute of Health Research (NIHR)

www.nihr.ac.uk

NHS Improving Quality

www.nhsiq.nhs.uk

**The Productive Series – releasing time to care,
NHS Improving Quality**

www.theproductives.com

References

Arnheiter, E.D., Maleyeff, J., (2005) "The Integration of Lean Management and Six Sigma", the TQM Magazine, Vol.17, No.1, pp.5-18.

Bamford, D., Forrester, P., (2003) "Managing planned and emergent change within an operations management environment", International Journal of Operations & Production Management, Vol.23, Iss.5, pp.546-564

Bamford, D., Thornton, H. & Bamford, J., (2009) "Health-care logistics redesign", Operational Research Society Vol. 22, pp.140-152.

Bamford, D., (2011) "The Lean Leadership Paradigm", Session at Lean Management Journal Annual Conference, June 2011, Birmingham, UK.

Bamford, D., Forrester, P. & Ismail, M., (2011) "Analysing approaches to technology transfer in the UK National Health Sector", OR Insight, Vol.24, Iss.2, pp 90-109

Bamford, J., (2013) "Healthcare Transport in Bradford: A case study in Service Transformation" in Overcoming Challenges to Healthcare Transformation Seminar, 12 November 2013, Huddersfield, UK.

Bevan, H., Corrigan, C., and Plesk P., (2003) "NHS Modernisation: making it mainstream. A commentary on the research report", London: Modernisation Agency, unpublished working paper.

Boaden, R., Harvey, G., Moxham, C., Proudlove, N., (2008) "Quality Improvement: Theory and Practice in Healthcare", NHS Institute for innovation and Improvement, Coventry.

Bradley, A., (2010) "Re: A new definition of social media [Web log message]". URL: http://blogs.gartner.com/anthony_bradley/2010/01/07/a-new-definition-of-social-media/ [1 April 2014]

Brandao de Souza, L., (2009) "Trends and approaches in lean healthcare", Leadership in Health Services, Vol.22 No.2, pp.121-139.

Breyfogle, F., Salveker, A., (2004) "Lean Six Sigma in Sickness and in Health", Smarter Solutions, Austin, TX.

Dehe, B., (2013) "Lean Thinking and Decision Making Application within The NHS" [Online]. Available from: <http://www.hud.ac.uk/research/researchcentres/boscat/leanhealthcare/resources/> [6 April 2014]

Department of Health, (2000), "The NHS Plan", London: The Stationery Office.

Department of Health. (2006) Annual report, London: The Stationery Office.

Fillingham, D., (2007), "Can Lean save lives?", Leadership in Health Services, Vol.20, No. 4, pp.231-241.

Goldratt, E., Cox, J., (2004) "The Goal: A Process of Ongoing Improvement", Third Edition.

Henneman, T., (2010), "Companies making friends with social media", Workforce Management, available from: www.workforce.com/section/10/feature/27/11/92/index.html [1 April 2014]

Howell, G.A., Ballard, G., (1998) "Implementing Lean Construction: Understanding and Action", IGLC-6, Guarujá, Brazil.

Huang, J.J.S., Yang, S.J.H., Huang, Y.M., & Hsiao, I.Y.T., (2010) "Social learning networks: Build mobile learning networks based on collaborative services", Educational Technology & Society, Vol.13, No.3, pp.78-92.

Institute for Healthcare Improvement, (2005), "Going Lean in Health Care. Innovation Series 7", Cambridge, MA: Institute for Healthcare Improvement.

King's Fund, (2011) "How is the NHS Performing? Quarterly Monitoring Report - April 2011", available from: www.kingsfund.org.uk [20 December 2013]

Kollberg, B., Dahlgaard, J., Brehmer, P.O., (2006) "Measuring Lean Initiatives in Healthcare Services: Issues and Findings", International Journal of Productivity and Performance Management, Vol.56, No.1, pp.7-24.

LinkedIn, (2014) *Global Audience*. URL: <http://emea.marketing.linkedin.com/audience/global-audience/> [12 June 2014]

Macomber H., and Howell G., (2003) "Linguistic Action: Contributing to the Theory of Lean Construction". Proceedings of International Group of Lean Construction 11th Annual Conference, Virginia Tech, Blacksburg, Virginia, July 22-24.

Matzek, M., (2006), "ThedaCare, Affinity adopt 'lean' mentality to improve service", Knight Ridder Tribune Business News, Washington.

Mid Staffordshire NHS Foundation Trust Public Inquiry, (2013) "Report of the Mid Staffordshire NHS Foundation Trust Public Inquiry". London: The Stationery office

NHS Improvement, (2010) "Bringing Lean to Life", available from: www.nhs.uk/resource-search/publications/nhs-imp-lean.aspx [12 June 2014]

NHS Institute, (2007) "Going Lean in the NHS", NHS Institute for Innovation and Improvement, Warwick.

NHS Institute, (2008) "Quality Improvement: theory and practice in healthcare", Coventry: NHS Institute.

Nuzum, R., McCarthy, D., Gauthier, A., Beck, C., (2007) "Denver Health: A High-Performance Public Health Care System", The Commonwealth Fund, 63, available from: www.commonwealthfund.org/publications/publications/show.htm?docid=509163. [January 29 2008]

Ohno, T., (1988) "Toyota Production System: Beyond Large-scale Production", Productivity Press, Portland, Oregon.

Papalexi, M., Bamford, D., Dehe, B., (2013a) "Lean Deployment in Healthcare: A systematic literature review". In BAM2013 Conference proceedings, British Academy of Management, Liverpool, 10th - 12th September 2013

Papalexi, M., Bamford, D., Dehe, B., (2013b) "A comparative analysis of Lean implementations in healthcare – UK and USA", University of Huddersfield, unpublished working paper.

Radnor, Z., (2010) "Transferring Lean into Government", Journal of Manufacturing Technology Management, Vol.21, No.3, pp.411-428.

Radnor Z., (2011) "Implementing Lean in Health Care: Making the link between the approach, readiness and sustainability", International Journal of Industrial Engineering and Management, Vol. 2 No.1, pp.1-12.

Radnor, Z. and Boaden, R., (2008) "Editorial: Lean in the public services: panacea or paradox?", Public Money and Management, Vol. 28, No.1, pp.3-6.

Raja, U., Rudge, L. and Godfrey, E., (2008) "Sustaining Continuous Improvement in Histopathology – Two Years On. Case Study: Calderdale & Huddersfield NHS Trust", NHS Improvement, London

Rowlands, I., Nicholas, D., Russell, B., Canty N. and Watkinson, A., (2011) "Social media use in the research workflow", Learned Publishing, Vol.24, No.3, pp.183-195

Safayeni, F., Purdy, L., Van Engelen, R. and Pal, S., (1991) "Difficulties of Just-in-Time Implementation: A Classification Scheme", International Journal of Operations & Production Management, Vol.11, No.7, pp.27-36.

Shanley, W., (2007) "Interview: Dr. Patricia Gabow", The Denver Post, January 14.

Silvester, K., Lendon, R., Bevan, H., Steyn, R. and Walley, P., (2004) "Reducing waiting times in the NHS: is lack of capacity

the problem?”, *Clinician in Management*, Vol.12 No.3, pp.105-11.

Taguchi, G., (2005) “Taguchi’s Quality Engineering Handbook”, John Wiley and Sons, Hoboken, New Jersey.

Tuck, R., (2009) “NHS Doncaster’s Innovative Approach to Redesign its TIA Pathway, to Introduce a Rapid Access One Stop TIA Clinic that Includes Immediate Preventative Treatment and Vascular Review, Case Study: NHS Doncaster”, *NHS Improvement*, Stoke and London.

Waring, J. and Bishop, S., (2010) “Lean healthcare: Rhetoric, ritual and resistance”, *Social Science & Medicine*, Vol.71, No.7, pp.1332-1340.

Westwood, N., James-Moore, M., Cook, M., (2006) “Going lean in the NHS”, *NHSI, Niflail*, London.

Williams, D.L., Crittenden, V.L., Keo, T. and McCarty, P., (2012) “The use of social media: an exploratory study of uses among digital natives”, *Journal of Public Affairs*, Vol.12, No.2, pp.127 -136.

Womack, J., Jones, D., (1997) “Apply Lean Thinking to a Value Stream to Create Lean Enterprise”, *Management Theory*, pp.11-14.

Womack, J., Byrne, A.P., Flume, O.J., Caplan, G.S., Toussaint, J., (2005) “Going lean in healthcare”, *Institute for healthcare improvement*, Cambridge.

Young, T. and McClean, S., (2008) “A critical look at lean thinking in healthcare”, *Quality and Safety in Health Care*, Vol.17, pp.382-386.

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