

TAXONOMY OF LEAN IN HEALTHCARE: A FRAMEWORK FOR EVALUATING ACTIVITY AND IMPACT

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Abstract

The purpose of this paper is to report our findings in relation to how lean is being implemented in English hospitals and what is the impact of different approaches to lean implementation on organisational performance. The paper identifies varied approaches to lean implementation by English hospitals and presents for the first time a 'taxonomy of lean' for public services. The unique methods of data capture are described and the paper provides quantitative evidence of the impact of lean in relation to the approach of implementation.

Keywords: Lean, Healthcare, Implementation

Introduction

Public Sector organisations over the past few years have experienced a rise in focus of the use of business process improvement methodologies particularly Lean and Six Sigma (Radnor and Boaden, 2008). The evidence of their implementation includes Health (Guthrie, 2006; Fillingham, 2007), Central Government (Radnor and Bucci, 2007) and Local Government (ODPM, 2005; Seddon, 2004) organisations within the UK (Lodge and Bamford, 2008) and the US (Krings et al, 2006). The drivers for introducing business process improvement methodologies are stated as the need to reduce costs and increase quality (Oakland and Tanner, 2007). Within the public sector the drivers also include government initiatives (for example, the efficiency agenda (HM Treasury, 2008)), performance indicators, the introduction of new governance structures or technology, the threat of competition, the demand for increased efficiency and the need for service expansion with limited resources (Radnor and Walley, 2008).

Where business process improvement methodologies have been implemented in public services focused around processes and departments, the evidence indicates significant impact related to quality, cost and time and even satisfaction of both staff and customers. Many of the impacts reported have been in terms of tangible outputs such as reduction of (processing or waiting) time, increase in quality through a reduction of errors, reduction in costs (through less resource) (Silvester et al, 2004; Wysocki, 2004) as well as intangibles such as increased employee motivation and satisfaction and, increased customer satisfaction (Radnor and Boaden, 2008).

In a recent literature review carried out for the National Audit Office focusing on the use of Business process improvement methodologies in the Public Sector (Radnor and Bucci, 2008), 51% of publications sourced focused on Lean and 35% of those were in the Health Services. Lean projects in health care have become widespread. Virginia

Mason Medical Center in Seattle (USA), Flinders in Australia and the Royal Bolton NHS Foundation Trust in the UK have become celebrated examples of lean implementation in health care settings (see Bohmer, 2005; Ben-Tovim *et al*, 2007; and Fillingham, 2007). Gubb (2009) cites achievements of Flinders Medical Centre in Australia who after two and a half years of implementing Lean Thinking was doing 15-20% more work, with fewer safety incidents, on the same budget, using the same infrastructure, staff, and technology; likewise the same author cites Bolton NHS Foundation Trust having reduced its average turnaround time in pathology from over 24 hours to 2-3 hours using less space and fewer resources.

The purpose of this paper is to report our findings in relation to how lean is being implemented in English hospitals and to attempt to determine the impact of lean implementation on organisation wide performance. A snapshot of lean implementation was facilitated via an analysis of the annual reporting documents of all 152 general hospital trusts in England. The aim was to determine which hospitals purport to be implementing lean and *how* they are doing so. Initially the study was designed to help us identify suitable case studies for a wider research project that investigates the use of modelling in conjunction with lean in healthcare. The findings however were particularly interesting in that a clear set of distinctive approaches to lean implementation emerged from the dataset which may provide a platform for testing the impact of lean at an organisational level in relation to the type of implementation approach taken.

Background to UK healthcare system

The UK National Health Service (NHS) has been in existence since 1948 and has a core value of providing a service that is free for everyone at the point of use. Hospitals are managed by ‘acute trusts’, whose function is to ensure that hospitals provide high-quality health care, and that they spend their money efficiently. The trusts also decide on a strategy for how the hospital will develop, so that services improve (NHS Choices, 2009). Some Trusts in the UK are now called ‘Foundation Trusts’ and this differentiates them from NHS Trusts in that they “*have greater financial and operational freedom*”(NHS Choices, 2009) in response to the Governments drive to devolve decision making from central to local government (Monitor, 2009). To achieve foundation status trusts are rigorously assessed for sustainable financial management; so far the independent regulator of foundation trusts ‘Monitor’ has awarded foundation status to 71 acute trusts since they began in 2004. This paper focuses on 152 ‘acute Trusts’ in England including Foundation and non-Foundation Trusts who provide a wide range of services including accident and emergency hereafter collectively referred to as ‘hospital trusts’. This study excludes hospital trusts that provide specialist services, for example, children’s specialist hospitals, women’s hospitals and, cancer hospitals.

Lean Thinking

Lean is hailed as the most important contribution to Operations Management in more than 50 years (Slack *et al*, 2007). Originating from the Toyota Motor Corporation, Lean (also referred to as the Toyota Production System) claims to be a radical alternative to the traditional method of mass production and batching principles for optimal efficiency, speed and cost.

Womack and Jones (1990 and 1996a) are regarded by most as the originators of the term ‘Lean Thinking’ and its associated principles. The five core principles of Lean,

based on an underlying assumption that organisations are made up of processes, are (Womack and Jones, 1996; Porter and Barker, 2005):

1. Specify the value desired by the customer.
2. Identify the value stream for each product/ service providing that value and, challenge all of the wasted steps.
3. Make the product flow continuously. Standardise processes around best practice allowing them to run more smoothly, freeing up time for creativity and innovation.
4. Introduce pull between all steps where continuous flow is impossible. Focus upon the demand from the customer and trigger events backwards through the value chain.
5. Manage towards perfection so that non-value adding activity will be removed from the value chain so that the number of steps, amount of time and information needed to serve the customer continually falls.

Whilst all five principles are instrumental to the implementation of Lean Thinking, the most important element is argued to be the first element 'specifying and identifying the value'. As Womack and Jones (1996) state "*failure to specify value correctly before applying lean techniques can easily result in providing the wrong product or service in a highly efficient way.*"

Lean Thinking and Healthcare

Young and McClean (2008) provide a discussion of the indeterminate nature of 'value' in a healthcare setting reporting a range of interpretations and perspectives. This research defines value from the perspective of the 'patient pathway' which refers to the route that a patient will take from the period of entry into the hospital until the patient leaves i.e. to design pathways around the creation of value to the patient at each step rather than considering the range of patient centered activities such as radiology, pathology and ward care for example, as isolated processes or functional silos (Young and McClean, 2008). An approach to lean based on the above principles should remove duplicate processes and unnecessary procedures such as: recording patient details in multiple formats and places, patients being moved to wards before beds are available, patients being moved from one ward to another; excessive waiting for doctors and consultants and long and uncoordinated discharge processes resulting in a longer length of stay than necessary (NHSI, 2007).

Lean is increasingly prevalent in healthcare (Radnor and Bucci, 2008; Young and McClean, 2008) however, a review of the literature suggests that few Trusts are implementing lean across the whole organisation, instead smaller enclosed projects using Lean methodology are creating 'pockets of best practice' (Radnor and Bucci, 2008) which at best may produce a plethora of unconnected projects that result in 'point optimisation' (Holweg and Pil, 2001; Hines et al, 2004) *but* could in turn have a negative impact on the patient pathway (Towill and Christopher, 2007). Royal Bolton NHS Foundation Trust is cited as the closest to a complete application of Lean in the UK (Radnor and Bucci, 2008). Spear (2005) concludes "*in healthcare, no organisation has fully institutionalised to Toyota's level the ability to design work as experiments, improve work through experiments, share the resulting knowledge through collaborative experimentation and develop people as experimentalists*".

Data Collection Method

The purpose of the research was to understand how Lean is being implemented in English hospitals in order to distinguish between hospitals that are using a few lean

tools in an isolated fashion from those who are implementing Lean in a more systemic manner; i.e. using Lean methodology to bring about organisation wide change as opposed to the optimization of one aspect of the system.

A snapshot of lean implementation in English hospital trusts was facilitated through a systematic examination of a range of secondary sources. The Annual Reports published in 2008 of all 152 acute trusts in England were accessed and analysed for evidence of lean led improvement activity. Every hospital trust in the UK publishes an annual report of their activities over the previous 12 months for presentation to Parliament (pursuant to Schedule 7, paragraph 25(4) of the National Health Service Act 2006). These reports are publicly available generally adopting a standard structure whereby the Chairman of the Trust makes a statement followed by the Chief Executive about the “highs” and “lows” of the past year with the remainder of the report (usually between 50 and 100 pages in length) highlighting specific achievements, events and activities. The statements of the Chief Executive and Chairman tend to be a reflective account of the state of play of the organization. It appears to be designed to inspire staff and the public to work together, to continue the good work of the past year and to strive for further improvement in the next. From this narrative, the following information about the individual trusts can be derived:

- Indications of a successful/disappointing/difficult year;
- Attitude/drivers for service improvement e.g. a ‘turnaround’ trust or one that claims to be at the forefront of innovation and service improvement;
- Financial circumstances: whether the Trust has considerable historical debt or a healthy surplus;
- Key achievements and what the Trust does well.

In order to identify evidence and examples of Lean activity embedded within the Annual Report a search string was applied to scrutinize the report for evidence of Lean implementation. The following keywords were searched using the search function of the ‘pdf’ document:

- ‘Lean’, as evidence of an application and/or awareness of Lean methodology;
- ‘productive’, as evidence of implementation of the national productive ward programme which is an application of the 5S technique which is commonly associated with Lean;
- ‘releas’, as above, the tag line ‘releasing time to care’ is found to be used synonymously with productive ward;
- ‘waste’, as possible evidence of an application of Lean methodology.
- ‘service improvement’ to highlight activities related to service improvement that may or may not be led by Lean methodology.

The above method identified trusts who claim within the context of the annual report to be actively using Lean methods; the search words were often embedded within a description of Lean application, service improvement/transformation or pathway redesign projects.

It is acknowledged that information presented in Annual Reports may be incomplete or distorted and it may be that hospitals are using lean methodology but have not mentioned this in their report. In order to help counterbalance this, we performed an analysis of individual Trust websites for hospitals that did not make reference to lean in their Annual Reports. Some did cite lean activities in, for example, ‘minutes’ of meetings, staff magazines or documents outlining a tender for Lean consultants. This hidden ‘grey literature’ was identified using an identical search string on the

corresponding trust website. Overall, the method was particularly useful in that the information was both readily obtainable and reliable in the sense that the description of lean activity can be validated through repetition. The method also and avoids many of the complications associated with the traditional survey method, such as achieving an appropriate response rate from the appropriate persons in any given amount of time. Information was successfully collected from each of the 152 trusts identified in England in a uniform manner.

In addition to collecting data relating to Lean implementation, the research also sought to collate data on a range of variables that may have a bearing on the nature of Lean implementation and/or on the performance of the hospital. All data used for this analysis is freely available and obtained in the main from the annual reports relating to the year 2007/08 and the respective hospital trust websites. The collection of the data in this manner and the emergent categorization of types of Lean implementation are uniquely held in a purposely designed database.

The range of additional data collected includes: size of trust (number of beds, staff and turnover), size of population served, demographic data relating to the density of population associated with the local areas served, notes relating to ethnic diversity, proportion of elderly/young people and any other information/characteristics relating to the general health and wealth of the local population. Location characteristics such as whether the Trust is situated in an industrial part of the country, a tourist area, rural area or city centre was also considered useful as the nature of the population served by the Trusts often dictates the nature of hospital attendance and admission. For example, a popular tourist area tends to have a very high number of A&E attendees during the summer months; a coastal area may have high numbers of elderly; an industrial area may have greater proportion of life limiting illnesses, respiratory disease and shorter life expectancy. Information from independent bodies and regulators such as Monitor, Dr Foster and the Care Quality Commission (formerly the Health Care Commission) was also collected and helped to build a very comprehensive dataset to portray a snapshot of healthcare in England.

Findings

Our sample of 152 hospital Trusts identified that 53% (80 Trusts) cite the application of Lean in their Annual Reports 2007/08 and/or in literature identified through the corresponding trust website. The claims within the reports regarding the application and implementation of Lean are discussed below.

Systemic Approaches to Lean

Five Trusts were identified as taking a 'systemic' approach to lean. These trusts cite a cultural view of lean implementation in that staff at all levels are empowered and engaged in experimenting and improving the way things are done on a continuous basis. For example, Brighton and Sussex University Hospitals NHS Trust outline a thorough approach to Lean alongside an application of six sigma and bed modelling in a document entitled 'Lean Thinking' (Trust Board Meeting: 2nd October 2007). Organisation wide transformation is the stated goal of the trust alongside the fostering of "*a supportive culture in which we learn from mistakes, share best practice and encourage staff to maximise their potential*" (Brighton and Sussex Annual Report, 2008 p.2)

Shrewsbury and Telford Hospitals NHS Trust describe Lean as a system whereby members of staff are more closely involved in management decision-making and are encouraged to identify and address problems in the working environment. The Trust

also clearly states a number of primary aims in relation to service improvement that echo the 5 principles of lean described earlier. The stated aims are to “*embed a culture of sustainable continuous improvement within the organisation, placing a clear priority on putting patient care first. Achieve measurable efficiency and productivity gains by the complete and thorough elimination of waste throughout the entire patient journey. Pursue excellence within service provision to ensure we are the provider of choice for our customers*” (Shrewsbury and Telford Annual Report 2008 p.30)

Plymouth Hospitals NHS Trust cites a Lean/Six Sigma Transformational Change Programme and refers to an integrated approach to service design (Plymouth Annual Report, 2008, p.32). Blackpool Fylde and Wyre (BFW) cite lean implementation alongside the development of the ‘*Blackpool Way*’ focusing on staff involvement and continuous improvement of the patient pathway (BFW Annual Report, 2008 p.18). Finally, Bolton have adapted lean methodologies to form the Bolton Improving Care System (BICS) which has enjoyed much worldwide attention and is acknowledged to be “*increasingly underpinning everything we do*” (Bolton NHS Foundation Trust Annual Report 2008, p.8).

Each of the above trusts, identified as taking a systemic approach towards lean implementation, recognise the importance of employee behaviour and culture as the key enablers of long term organisation wide change.

Other identified approaches to Lean implementation

A number of other approaches to lean implementation were identified through the data collected, ranging from small scale scoping projects or lots of small change, to a range of interconnected projects under an organisation wide transformation or service improvement programme. Some hospitals were identified as being in early and preliminary stages of implementation, reporting pilots of lean activity with a small team of people. In some cases ‘invitations to tender for lean consultants’ were identified. The UK NHS Institute for Innovation and Improvement (NHSI) point to evidence that bringing ‘outside-in’ change capability (consultancies and external experts), can add change momentum (NHSI July 2008).

The Productive Ward was a frequently cited initiative led by the NHSI that presents a systematic way of making improvements on the ward through a relatively straightforward application of the Lean technique ‘5S’. 5S is a workplace discipline used to ensure reliable work practices and a clean working environment. The Productive Ward (PW) initiative comprises a toolkit and a number of modules to take staff through the transformation step by step; following a period of intensive testing in acute trusts by the NHSI, the productive ward has proven successful at improving ward processes and environments to help nurses and therapists spend more time on patient care thereby improving safety and efficiency.

Rapid Improvement Events (RIE’s) and Kaizen events are another frequently cited Lean tool. Alukal (2007) defines a Kaizen team as one where multi skilled, cross trained and cross functional people get together for a certain task and then disband. Implementation via a disciplined cycle of RIE’s is a prominent feature in hospitals implementing Lean. RIE’s can be useful for embedding Lean in an organisation as demonstrated by Bolton Hospitals where Fillingham (2007) describes a seven week rolling cycle of planning, executing and following up change.

Lean Taxonomy

The examination and analysis of the Annual Reports of all trusts in England discussed above provides strong evidence that a variety of approaches to Lean implementation

have and are being taken. From this we identified six categories of approach to Lean implementation which are presented in Figure 1.

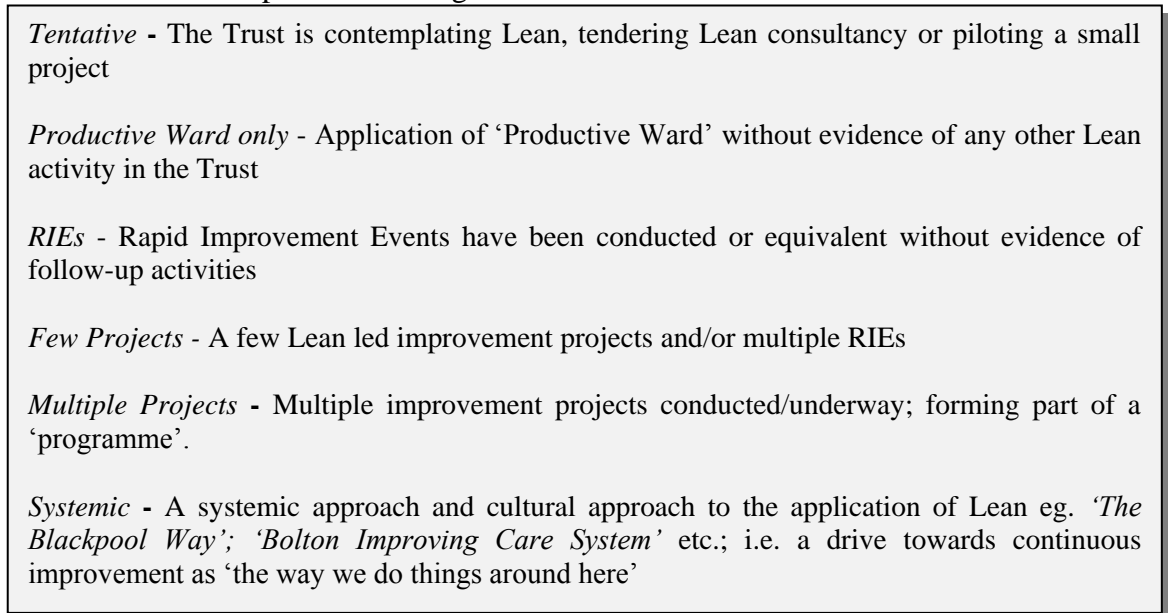


Figure 1: Taxonomy of Lean

Dissemination of Implementation Approaches

Figure 2 presents a graph illustrating the varied nature of approaches to Lean implementation in English Hospital Trusts deduced from the analysis of hospital trust annual reports and websites.

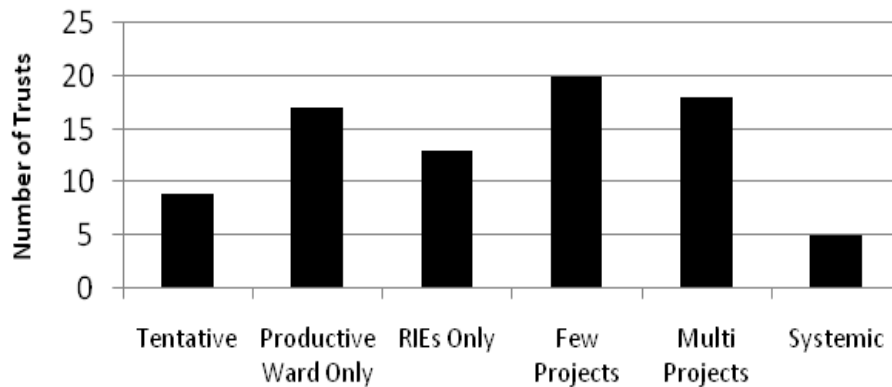


Figure 2: Method of Lean Implementation in English Hospital Trusts

No single approach to Lean implementation appears truly to dominate the sample. The most frequent category of approach to implementation suggested by the dataset is in the form of ‘few projects’. This finding was largely anticipated and supports the picture projected from the extant literature: many trusts who are implementing Lean are doing small projects that do not form part of an integrated approach to service improvement (Young and McClean, 2008; Radnor and Bucci, 2008; Spear 2005; Granville, 2006).

Discussion

Figure 2 depicts a picture of Lean implementation whereby the vast majority of approaches are not systemic with only five hospitals identified from the reports as

taking a systemic approach. However a number of hospitals are taking a multiple project approach to implementation. The remaining Trusts appear to be taking a more short term approach that is tool based rather than principle led.

Spear (2004) cautions that where organisations merely imitate the tools and not the principles of Lean the result is a rigid inflexible system. Indeed, David Fillingham, Chief Executive for Bolton Hospitals NHS Trust warns:

“The risk in creatively adapting lean initiatives to suit your own organisation is that their essence can easily be lost. It can degenerate into just another quality drive, or worse still, a set of talking shops in which nothing gets done. The trick is to recognise the core elements of a lean approach and embody them in all you do.”

(Health Service Journal, 17th October 2008)

The ‘Productive Ward’ (PW) was the most frequently cited type of Lean implementation. Some hospitals seemed to regard PW as distinct from other Lean activity whilst others regarded PW as synonymous with Lean methodology. From the analysis, the uptake of PW is very prolific amongst hospital Trusts in England. This taxonomy distinguishes trusts applying the PW in an isolated fashion without any further reference to Lean activity from those applying PW alongside other Lean methods. A significant proportion of hospital trusts fall into the former category. The driving force behind the prolific uptake of PW is most likely that *it works*; however, a full evaluation of the impact of the initiative has not been conducted yet and is currently underway.

RIEs are frequently used to kick start projects however this taxonomy distinguishes between hospitals using one or two RIEs to produce localized improvements with limited scale up to activity that forms a ‘project’. Radnor and Bucci (2008) warn that organisations focusing on just tools and techniques, particularly RIEs could fail to align improvement with strategy thereby getting caught up in the here and now rather than the ‘then’. As a result, sustainability activities such as developing a culture of ongoing and structured problem solving become neglected.

Productive Ward ‘only’, RIEs and small isolated projects are functionally orientated i.e. focused upon one aspect of the patient pathway (the ward, pathology department, waiting lists etc). The output is ‘point optimization’ akin to ‘islands of optimization’ defined by Holweg and Pil, (2001) whereby the affected function is run efficiently and effectively but all other aspects of the pathway either stay the same or in some cases, can actually have a negative impact on the wider system where process changes in one place have shifted the bottle neck or created new problems in other parts of the pathway (Towill and Christopher, 2007).

Many authors make the point that simple improvement measures are seldom effective (Grol *et al*, 2004; Proudlove *et al*, 2008; Bevan *et al*, 2005); the ramifications of this type of Lean implementation are that benefits are localized, unlikely to be sustained and may even have a negative impact on other parts of the system.

Lean Implementation and Trust Performance

The taxonomy provides a platform for testing possible relationships between the category of Lean implementation and a range of other variables. This section of the paper reports results of a test for a possible relationship between the types of Lean implementation and Trust performance as a measure of impact that is linked to activity.

Performance is measured annually by the UK Healthcare Commission which recently became the Care Quality Commission (CQC) established April 1st 2009. The

Healthcare Commission uses an explicit set of performance criteria to award scores of Excellent; Good; Fair; or Weak under two main categories: Use of Resources and Quality of Services. The Use of Resources refers in the main to the financial steering of the Trust; Quality of Service refers to measures such as waiting time targets, number of patients with healthcare acquired infections (HAI) and so on. For this analysis the results published in October 2008 are used.

Figures 3 and 4 test a ‘null hypothesis’ of: ‘trust performance is independent of the approach to Lean implementation’ using the non parametric test chi-square. The very high *p* values indicate that this hypothesis can not be rejected under either category of performance measures.

Rows: Lean- 4cat		Columns: Res- 2 cat	
	1	2	All
0	29	47	76
1	13	21	34
2	8	17	25
3	7	10	17
All	57	95	152

Pearson Chi-Square = 0.443, DF = 3,
P-Value = 0.931
Likelihood Ratio Chi-Square = 0.449, DF = 3,
P-Value = 0.930

**Figure 3: Tabulated statistics
‘Lean Implementation & Quality of Service’**

Rows: Lean- 4cat		Columns: Qual -2cat	
	1	2	All
0	17	59	76
1	7	27	34
2	4	21	25
3	3	14	17
All	31	121	152

Pearson Chi-Square = 0.560, DF = 3,
P-Value = 0.906
Likelihood Ratio Chi-Square = 0.576, DF = 3,
P-Value = 0.902

**Figure 4: Tabulated statistics
‘Lean Implementation & Use of Resources’**

Figures 3 and 4 provide evidence that the approach to Lean implementation has no impact on Trust performance.

The Chi- square test was then applied to the two performance measures ‘Use of Resources’ and ‘Quality of Service’ where a p-value of 0.003 confirms a very strong positive correlation i.e. a strong performance score for Quality of Service is highly correlated to a strong performance score for Use of Resources. This finding provides statistical evidence that the two categories of performance measures used by the Healthcare Commission are correlated. Therefore, it should be possible to consider that using these performance measures, a truly systemic adaptation of Lean by Hospital Trusts should also correlate positively with performance.

An explanation for the lack of impact of lean implementation on organizational performance is that very few trusts are perceived to be taking a systemic approach towards Lean. As already discussed, a project based approach will only result in point optimization and can negatively impact the system as a whole as solving a problem in one part of the system could cause another problem in another part of the system. Secondly, recognizing that Lean implementation in healthcare is still in its embryonic stages a process of evolution is likely to be necessary to adapt Lean to the intricacies and ‘special twists’ (Guo, 2004) of healthcare. The implementation of Lean is often described as ‘a journey’ – with the various stages of the implementation being landmarks of the total journey (Bicheno, 2004; Radnor and Bucci, 2007).

Conclusion

This research presents a possible Lean Taxonomy in healthcare which facilitates a distinction between hospitals who are attempting to embed Lean into the whole hospital and those who are merely using a few tools and techniques commonly associated with Lean. The analysis of 152 Hospital Trusts within the UK has given rise to a number of

categories in relation to the approach to Lean implementation. These categories range from Systemic approaches to multiple projects, a few projects, rapid improvement events, productive ward only and 'tentative' to lean as described.

This taxonomy has two important consequences. First, it facilitates for the first time an assessment of the range of implementation activity of hospital trusts in relation to Lean. Second, it allows some quantitative analysis of the impact of Lean activity upon various aspects of healthcare, including the Healthcare Commission performance measures of Quality of Care and Use of Resources as demonstrated in this paper.

The taxonomy presented here provides a useful benchmark for monitoring the approach taken to the implementation of Lean. We anticipate that the type of implementation approach taken by hospitals may influence the success of Lean methodology in improving trust performance.

This paper represents a first step to understand the adoption or more specifically 'adaption' of lean thinking to healthcare in the English NHS. The ongoing research seeks to validate these levels through further qualitative evaluation of trusts and their implementation methods through case study analysis.

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