

Improving lean capabilities: awareness and achievement

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Abstract

With a particular focus on manufacturing firms in Ireland, this paper explores the overall question: *From the perspective of competitive progression theory, how and in what areas do firms improve as they engage in a tiered improvement programme?* The aim of this research is to contribute to the literature on lean capabilities and their progression towards maturity. The research explores an approach at national level for the development and application of systematic and programmatic tiered interventions to encourage dynamic learning and the development of lean organisational capabilities.

Keywords: Operations improvement, lean operations

Introduction

The Lean Business Offer (LBO) is a three tiered programme delivered by Enterprise Ireland (EI) to help firms to improve their operations-based competitiveness. EI is the State body charged with the support and development of indigenous industry, and of multi-national corporations using natural resources. To date, 823 firms have participated in the LBO programme supported by EI. Earlier analysis of the broad set of LBO firm-level data suggests that the development of lean capabilities is enabled through such a tiered programme (Coughlan, Fynes, Keegan & Ledwith, 2015). The tier, sequence, duration and timing of engagement seem to be material to the capability improvements achieved. For example, participating firms exhibit differing paths through the tiers of the programme. Some engage at a single tier and go no further. Others migrate from one tier to the next in the sequence envisaged by the LBO developers. Correspondingly, levels of performance depend upon the starting point and the extent of migration from one tier to the next. Of particular note is the evidence of different impacts depending upon the number of improvement projects engaged in or the sequential progression from one tier to the next. This evidence prompts the focused question to be explored in

this paper: *From the perspective of competitive progression theory, how and in what areas do firms improve as they engage in a tiered improvement programme?*

Competitive progression theory (CPT) builds on the earlier contribution of Ferdows & De Meyer, (1990) with regard to the “sand cone” model, see Figure 1. In this model, the authors posit that capabilities are cumulative (as opposed to either/or choices), and subject to a specific sequence of implementation (Rosenzweig & Roth, 1994). They observed and found that each of the generic capabilities (quality, delivery, flexibility, cost) had a significant predictive sequential effect on each other. CPT contends that not only are generic capabilities complementary and sequential but they are also subject to diminishing returns because of the technological constraints that firms are subject to.

The literature on lean is extensive. The introduction of a lean approach to management requires the development of understanding and capability (Wynton & Payne, 2013). This, in turn, requires a structured intervention consistent with a stepwise approach towards the elimination of waste. So, implementation of lean is not an instantaneous transformation within the firm. Voss, Blackmon, Cagliano, Hanson and Wilson, (1998) concluded that a successful and growing community of SMEs needed to adopt progressively practices, such as lean production, of larger world-class companies. They recommended that policies aimed at encouraging or sustaining employment growth in SMEs ought to address both the diffusion of such practices and special support for the smallest among them. This work raises the challenge in practice of diffusion of capabilities and the ways in which SMEs might be enabled.

More recently, Netland and Ferdows (2014) explored the role of lean programmes in eliminating unproductive activities while increasing value creation. They argue that the relationship between a plant’s maturity in a production system implementation and its resulting performance was significantly positive and that it followed roughly the shape of an S-curve. The S-curve pattern implies that the rate of improvement in the plant’s performance changes in the shape of a normal distribution (the first derivative of the S-curve) as the plant becomes more mature in implementing the production system. In general, its performance improves slowly at first, and then at an increasing rate until the rate reaches a maximum level - after which the performance still continues to grow, but at a decreasing rate. Although performance remains at a high level, the rate of its improvement gradually decreases.

Drawing on this literature, this paper contributes to our understanding of lean capabilities and their progression towards maturity. It will build on our earlier research in the area of lean capabilities (Coughlan, Fynes, Wiengarten & Franken, 2011; Coughlan, Fynes, Keegan & Ledwith, 2015). More specifically, it will draw on evidence from firms participating in a national-level systematic and tiered programme in the context of CPT. By examining two sets of firms, one taking a more gradual, tiered approach and the second an advanced entry into the national programme, this study examines the ways that firms improve as they engage in a tiered improvement programme.

Design/ Methodology/Approach

The empirical work underpinning the paper was conducted in manufacturing firms who engaged in an initiative, the Lean Business Offer (LBO) which has three distinct tiers, each at a different level of intensity:

Lean Start – 7 day interaction, over 1-2 months,

Lean Plus – 3-6 months of activity,

Lean Transform – Over 2 years activity.

The offer is explained graphically as a “Spiral of Improvement” as firms develop the capability and capacity of their people and processes (Keegan, 2000). The Irish State assists firms financially on their Lean journeys, through the LBO, and receives impact reports on their efforts and results. Firms work with their designated EI client relationship staff member to identify their suitability for the LBO and at what level, Lean Start, Lean Plus or Lean Transform. Firms are then encouraged to interview and select a suitable consultant from an EI directory. Consultants have to show that they have experience and expertise with Lean implementation before they are accepted on to the directory. Also, EI convene Spring and Autumn Fora where the progress of the programme is discussed with the consultants and where issues and opportunities are considered. For the Lean Transform cases a multi skilled core team from EI typically engage with the leadership team in the client firm to achieve a consensus on the scope and the focus of their proposed Lean Transform activity, before the company interview and select their consultants. The underlying rationale is that this scoping and consensus building before consultant engagement helps ensure that the topics and areas chosen for improvement activities are the central issues and challenges for the business.

The data examined in this study include LBO level, timing and duration of engagement, and performance metrics including cost savings, output capacity, turnover, achieved and planned improvements. These data were provided by the participating firms directly to EI. The resulting dataset formed the basis for the study. The data examined are drawn from the broad set 823 LBO participants. Firstly, firm-level case studies explore objectives, key challenges, key changes and results in two firms as they engaged in the LBO programme. The case data were sourced from the Enterprise Ireland Lean Business Case Study collection, supplemented by data gathered using a previously validated survey (Bumblauskas & Meyer, 2015; Bumblauskas, Meyer, & Keegan, 2015) to understand firm-level management perspectives on the LBO participation.

Findings

Data set overview:

The LBO approach was piloted initially in 2009 and rolled out in 2010. In 2013 an independent evaluation of the LBO was commissioned by the Irish State and carried out by Technopolis. This report was published in April 2015 (Department of Enterprise, Jobs and Innovation, 2015), giving insight into the impacts being achieved through the adoption of the LBO. A number of metrics indicate the level of impact evaluated. They identified that, on average, the positive impact for companies engaging in the LBO over those who did not were equivalent to a 40% increase in sales, a 20% percent increase in productivity and an 11% increase in employment. The report identified many other improvements in operational performance such as on time deliveries and quality improvements.

The broad dataset contains details of 823 LBO participants. A number of firms have undertaken more than one LBO project. Firms exhibited different starting points and engaged at different levels of the programme. 460 firms participated in one level only of the LBO. However, not all of these firms participated at the Start level. Rather, the distribution was as follows: Lean Start: 322; Lean Plus: 85; Lean Transform: 53. This

distribution would suggest that relatively few firms were developed enough to engage for the first time at the highest level within the programme. 274 firms participated at two levels of the LBO programme. Again, there were different patterns of engagement evident. While the dataset included data on all firms, some data were missing from a number of firms. As such, for the purposes of this paper, we identified a selection of firms for whom we had a full dataset. We identified 15 ‘first-tier-first’ firms that have gone through the Start and Plus tiers; and, eight ‘advanced entry’ firms that have started with the Plus tiers. These firms compete in different sectors including precision engineering, horticulture, electrical control systems, composite materials manufacturing, and management services. From this selection of ‘first-tier-first’ and ‘advanced entry’ firms, we selected two firms on which we had individual case study data.

Intervention benefits for firms engaging in LBO projects, starting at different levels: Table 1 summarises the benefits experienced by firms engaging in LBO projects. The benefits include annualised cost savings, cost savings as a percentage of sales, cost savings as a percentage of cost of goods sold, percentage output capacity increase, and other project benefits (e.g. defects, lead time, and potential impact on turnover). The firms are organised into two groupings: 15 firms which engaged in ‘first-tier-first’ firms that have gone through the Start and Plus tiers; and, eight ‘advanced entry’ firms that have started with the Plus tiers and plan to progress to the Transform tier.

The table indicates that for the ‘first-tier-first’ firms, the level of cost savings as a percentage of cost of goods sold realised from the Start and Plus level interventions more than doubled. There were corresponding increases. The commercial relevance of these cost savings is evident in the improvements in cost as a percentage of sales. The improvements arising from the Start initiatives focused on lead time reduction resulting in improved capacity utilisation leading to increased turnover. Other benefits reported by the start companies also indicate a focus on having basic processes in place; ‘*visual management now in place*’, ‘*much greater awareness of lean tools to deal with day-to-day problems*’, and ‘*customer service metrics now in place*’. The improvements arising from the Plus initiatives had a broader focus: quality, lead time reduction and employee involvement. Comments from participating companies focussed more on cost and efficiency; ‘*lead-time reduced by 30%*’, ‘*improved cash flow 30 days*’ and ‘*efficiency metric improved by 40%*’. These improvements led to increased turnover.

In contrast, the table indicates that for the ‘advanced entry’ firms, the level of cost savings as a percentage of cost of goods sold realised from the Plus level interventions was up to 26%, categorically higher than for the ‘first-tier-first’ firms. Additionally, the other benefits reported by these firms tended to be more strategic in nature; ‘*increase in capacity will support the company’s strategic plan*’ and ‘*customer service targets have been achieved and will be maintained*’. In contrast, however, the plans for these firms for cost reduction in a Transform level intervention were significantly less but with similar levels of capacity increase. This different combination suggests an increased awareness of cost drivers as a result of the Plus intervention and a correspondingly more focused but high yielding cost reduction intervention at the Transform level. In contrast also to the ‘first-tier-first’ firms, the improvements arising from the Transform initiatives focused on efficiency. However, as with the ‘first-tier-first’ firms, the commercial relevance of these cost savings is evident in the improvements in turnover. Plans for Transform level interventions targeted yield improvement.

Table 1 – Intervention benefits for firms engaging in LBO projects, starting at different levels

Pattern of Engagement	Intervention Benefits from...	Annualised Cost Savings	Cost Savings as a % of Sales	Cost Savings as a % of COGS	% Output Capacity Increase	Other project benefits (e.g. defects, lead time)	Potential impact on turnover
<i>'First-Tier-First' firms</i>	Start (15 companies)	Up to €150,000	Up to 4%	Up to 6%	Up to 40%	<ul style="list-style-type: none"> • <i>'visual management now in place'</i> • <i>'much greater awareness of lean tools to deal with day-to-day problems'</i> • <i>'customer service metrics now in place'</i> 	Better capacity utilisation expected to lead to increase in turnover
	Plus (15 companies)	Up to €650,000	Up to 6.3%	Up to 15%	Up to 30%	<ul style="list-style-type: none"> • <i>'lead-time reduced by 30%'</i> • <i>'improved cash flow 30 days'</i> • <i>'efficiency metric improved by 40%'</i> 	Realised increase in turnover of up to €2m.
<i>'Advanced Entry' firms</i>	Plus (8 companies)	Up to €204,000	Up to 21%	Up to 26%	Up to 21%	<ul style="list-style-type: none"> • <i>'increase in capacity will support the company's strategic plan'</i> • <i>'customer service targets have been achieved and will be maintained'</i> 	Up to 20%
	Transform (8 companies)	Up to €750,000	Up to 4.5%	Up to 9.5%	Up to 18%		Up to 22%

Case examples:

A deeper exploration of the experience of two firms yielded additional insights on objectives, progression towards sustainable improvement of lean capabilities and results of participation in the LBO programme. Each firm engaged in LBO projects, starting at different levels. We outline each case in turn.

Anord Control Systems:

Anord Control Systems Ltd. is a global provider of critical power equipment to the data centre, nuclear power and renewable energy sectors. Anord engaged in the LBO programme at Start and Plus levels, before continuing at a Transform level. The firm was prompted to engage in Lean Start by issues in the areas of dependability, employee engagement and speed. Before engaging in Lean Start, growth in demand was pushing the process against capacity limits and causing performance issues. The workplace was relatively disorganized and cluttered, it was confusing to work in and components of the processes did not seem to work well together. Anord made many changes to improve the processes, including fixing and replacing equipment, product redesign, work assignment change, reorganising the workplace and sequence of steps to make the flow better. In making these changes, staff engagement and allocation of time to implement were challenges. Overall an estimated 80% of the changes made were corrective and resulted in improvements in speed and cost.

The engagement in Lean Plus was prompted, in part, by the positive experience of Lean Start. The earlier growth-related pressures on capacity were still in evidence, components of the processes still did not seem to work well together and the throughput time of the processes was perceived to be too long. In response, Anord continued to make the flow better, adding fixtures or jigs to make the task more efficient. Staff and management engagement and developing an understanding of what was possible were challenges. Again, an estimated 80% of the changes made were corrective and resulted in improvements in speed and flexibility.

Together, the benefits of engagement at Start and Plus levels included an increase in output capacity and reductions in lead time and in overtime. The increased capacity meant that the company could produce additional sales orders within existing premises, with a corresponding positive impact on profitability. Anord progressed then to a project at the Transform level. The Transform project objectives included:

- To implement lean methodologies throughout all functions of the business
- Increased employee engagement in continuous improvement.

Again, there were key challenges. It was difficult to find similar “Engineered to Order” companies to benchmark against that had already employed lean methodologies. Further, as each “product” produced was unique and could involve customer changes at any time, the process could change at any time. As such, basic lean tools and methodologies such as takt time, one piece flow and value stream mapping were ineffective. Finally, they needed to develop metrics to drive continuous improvement.

Over the course of the project, they made some key changes. They moved to data driven from reactive problem solving. They identified Lean Champions to whom they gave resources to complete projects. They provided operators with a facility to offer improvement ideas and they introduced 5S workplace organisation in all functions of the business. The results were seen in a number of areas:

- Increased productivity of Stage 1 process by 20%.

- Improved stock control using Kanban for consumable goods.
- Removed double handling of material to secondary storage unit.
- Introduced a Kaizen suggestion scheme for process improvement, safety and facility ideas.

Glenpatrick Spring Water Co Ltd

Glenpatrick Spring Water Co Ltd is a market leading, innovative drinks producer specialising in retailer house brands and brand co manufacturing. Glenpatrick Spring sources its water from a conserved natural heritage area and operates in-line bottle blowing facilities, sports capping and reel-fed labelling.

Glenpatrick Spring engaged in the LBO programme at a Plus level, before continuing at a Transform level. The benefits of engagement at Plus level included cost savings, an improvement in overall equipment effectiveness (OEE) to best in class level and maintenance of customer service targets.

Glenpatrick Spring progressed then to a project at the Transform level. As part of this project, the firm began to take the learning from the OEE improvement and implement across other parts of the business. To achieve this objective, the firm undertook a number of initiatives. Glenpatrick Spring rolled out a Lean Awareness project out to all employees, supported by management development training – including behaviour assessment and coaching, and application of the Lean Production Planning Wheel. The firm established new filling line KPI's and undertook preventative maintenance of the new line and improved warehouse capacity management. The success of the project was to increase the OEE of the new filling line to the rated running OEE of 85% that would sustain over a three shift cycle. This objective was achieved through workplace organisation and changes to standard Work such as implementation of front line asset care by operators, identification of best practice for each of 17 changeover equipment points on the line and rollout of point of use training material to operators across three shifts, A3 problem solving, and implementation of Preventative Maintenance for the filling line with a software package to manage the PM annual program. In addition, the firm rolled out behaviour assessment to the Operation Manager and Production Managers and Core Behaviour Matrix to all employees to ensure right behaviours are aligned to job needs to drive the required performance.

Through the successful implementation of the Lean Transform program, the company has gained a competitive advantage over its competitors by operating through lean across the business. The lean training of tools and practices has been extended to the glass line with positive impact on metrics. Standard work is in place to ensure people do the job in the approved way in which they have been trained. A3 problem solving is used to define a problem and put in place corrective action counter measure. Cockpits are used effectively daily to run the business, ensuring performance is tracked, good communication exists and everyone is held to account in doing their jobs. Core behaviours have been rolled out as part of a performance management process to ensure people's mind-sets are aligned with the job requirement and to drive high performance across all areas of the business. OEE line performance on the filling line has been increased from 60% to 76% and yield loss has been reduced from 2.5% to 1.4%. This has resulted in an annualised cost saving of €750,000. Lean tools and practices are now embedded in the daily execution of the process to enable the team to continue the improvement journey to achieve 85% OEE.

Reflection:

The research offers a new empirical perspective on transition to lean operations. By analysing firm level data, process capability has emerged as fundamental to the achievement of lean performance. The benefits reported by the 15 ‘first-tier-first’ firms and the eight ‘advanced entry’ firms suggest a consistency with the Sandcone model. Initial benefits reported for the LBO Start level intervention focus on having the correct processes in place before moving onto the Plus level intervention where benefits relate more to cost and efficiency improvements. The ‘advanced entry’ firms generally showed evidence of more strategic improvements. The case data provides evidence of directed and dynamic learning and the development of lean organisational capabilities in the two firms. Their starting points in the LBO programme were different. However, they both achieved improvements in operational performance which translated into production-related cost reductions. The source of the improvements was different in each case. Anord, the “first-tier-first” firm, focused on improvements to layout and flow which, when achieved, enabled improved flexibility. Glenpatrick Spring, the ‘advanced entry’ firm, focused on improvements to overall equipment effectiveness and a reduction in yield loss. In both cases, the impact of these operational improvements was seen in cost reductions.

This observation prompts two conclusions which bring together the concepts of the Sandcone and improvement on the S-curve, as illustrated in Figure 1. First, in terms of the Sandcone, both firms based their initial improvements on direct contributors to process capability. The impact, operationally, was on product quality. This improvement in product quality translated into cost reductions. So, cost reductions flowed directly from the lowest (or foundation) level of the Sandcone instead of being mediated by the levels in between.

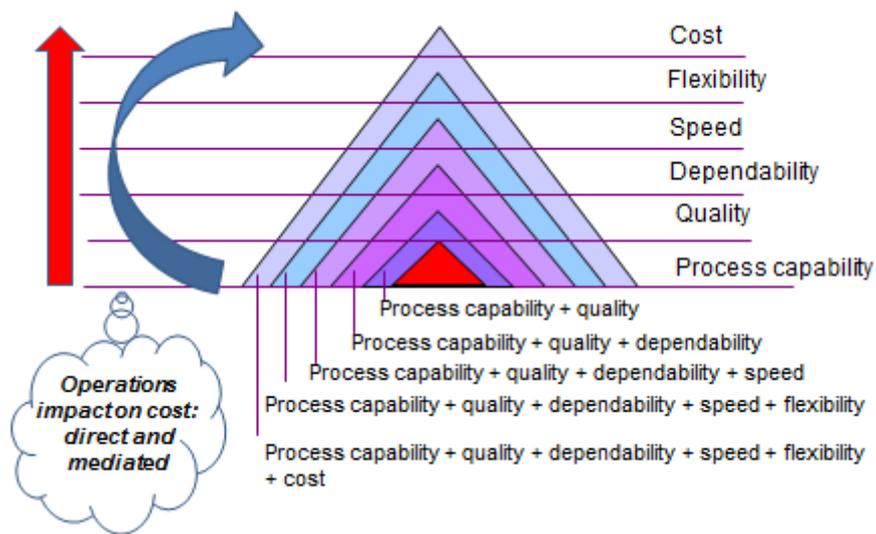


Figure 1: Linking the Sandcone and the S-curve

Second, the impacts achieved in the Transform projects built on the earlier LBO experiences. They might not have been achieved to the levels attained without the earlier LBO experience. In addition, the experience derived from earlier was, in each case, deployed across the wider organisations. In terms of the S-curve, the maturity

achieved was not just within the defined area of activity of the initial focus, but firm-wide.

These outcomes and impacts depended upon staff and management being able to talk the ‘language’ of lean, embedding continuous improvement and improved production planning through the use of standard work. Through participation, lean thinking began to permeate practice and role definition, key staff were trained on the use of Lean tools in their day-to-day activities, and project teams developed to help with new project introductions elsewhere in the firms. Correspondingly, organisation structures evolved to sustain continuous improvement, enabling regular structured mechanisms to drive ongoing change.

Relevance/Conclusion

The study supports the argument that a structured, sequential approach to implementing lean production leads to improved performance outcomes with respect to quality, cost and time-to-market. As such, the paper extends competitive progression theory within a lean production setting. The relevance for manufacturing practice is the role of sequential interventions in underpinning sustainable operational and cost performance improvements.

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