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Implementing lean—Outcomes from SME case studies

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ABSTRACT

The purpose of this work was to identify critical success factors for lean implementation. It followed two first-time implementations of lean in small to medium-sized enterprises (SMEs). The case studies collectively spanned over four years. It was observed that the real problem with achieving lean success was not management commitment but their ignorance of what they should commit to, hence a knowledge problem. This paper provides new insights into the role of knowledge as a causal factor in the successful implementation of lean and especially in organisations with limited resources. For practitioners, management knowledge needs active consideration in the implementation phase. Management knowledge is particularly significant in SME implementations due to their resource constraints. Researchers still need to define the success factors more explicitly, including the specific management commitments.

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1. Introduction

Lean arose in the automotive industry as means to reduce waste [1–4]. The benefit of this is not merely the reduction of waste per se, but the reduction of any non-value adding activity. Quality increases (while the cost of quality reduces), and utilisation of capital is improved. Organisational agility can be enhanced, and production lead times shortened. The principles are said to apply to businesses universally [3], and lean production has migrated to a broader field of implementation and termed lean management [5]. To practitioners lean is a, if not the primary methodology for systematic productivity improvement [6,7].

Lean has proved successful in a large variety of industries but still has its problems as evident in the many failed implementations [8]. Failure rates of 60–90% are typical for improvement programmes, [9–11]. And are comparable to the high failure rate of organisational changes [12], i.e. as high as 80% [13].

The benefits of lean have been publicised for over three decades [3,14]. The factors for lean success are becoming more evident [4,15,16], and many frameworks are developing [17]. Still, many organisations struggle to implement lean, especially in situations like small and medium enterprises (SMEs), where resources are scarce or processes are complex [10,18].

The present work assesses the critical success factors for a lean implementation, by studying SME cases, i.e. a qualitative case-study approach. From this, we identify that the commitment of management to the process is more important than the proposition and imposing of lean methods. We derive a conceptual model for the effect of the manager's knowledge on the process, and we conclude by identifying what it is that management commit to when they commit to lean.

2. Literature

Lean has high and positive prevalence in industry [6], with many successful cases recorded in the literature [4,19,20]. Nonetheless, the method is not without criticism. These include that it is exploitative of employees [21–23] as with just-in-time [24]. That it is a fad and not relevant beyond its mass production roots [19,25], lacking flexibility [26,27]. However, other management practices are similarly critiqued [28], and it is entirely possible that the success of lean implementation is merely contingent on covert factors [29,30].

The lean literature identifies that one of these critical success factors is the way it is applied. Lean implementation historically was viewed as a sequential application of tools [31], in a prescriptive process driven by expert consultants. From early stages, the *respect for humans* principle was identified as equally important as the methods of waste elimination [2,5], but in practice, the waste perspective has dominated. Now there is an increased realisation of the risks in the lean transformation and change manage-

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ment process [32–34]. Implementing lean in a piecemeal manner or focussing on the technical execution without recognition of the human factors is implicated in failure [16,35]. Hence the modern application promotes a deeper understanding of context and the needs of people [16,26,36]. Many models for change management have been developed [12,37–41]. The Lean Iceberg model [4,42] explains that the implementation of lean tools and processes requires invisible enabling factors of strategic alignment, leadership and engagement [4,10,16,36,43]. Hence, the exploration of culture as a success factor [44] amongst others [28,29] including environmental performance [45].

A robust implementation of lean requires an enterprise-wide management system [46] that creates a culture that empowers employees to solve problems and implement regular improvements [4,36]. This is made possible by an effective communication process, employee engagement, a shared vision, and collaboration [4,47]. The concepts of double-loop learning [48], the learning organisation [49,50], collaborative learning [51] and continuous learning [52] are therefore consistent with lean [4,47]. These further implicate knowledge management [53,54].

The importance of management commitment is highly stressed in the lean literature [4,55,56]. That is that the permanency of change is reliant on someone positioned appropriately and with a commitment to change (Boyle, Scherrer-Rathje, and Stuart 2011), and with behaviours consistent with the change [12]. Worley and Doolen's [57] summary of the literature reports that 'commitment by top management is vital', management 'intentionally or unintentionally sabotage' implementations and must 'work to create interest in the change' being 'visibly connected to the project'. These sentiments have also been explicitly raised for SMEs [58].

For SMEs implementing lean, on the positive side, they typically have a flat structure and simple systems, which promote flexibility to change and dissemination of knowledge [59,60]. On the negative side, there are limited resources, including capital and staff capabilities [10,18,60]. A typical SME may have only a few key employees and as their skills develop staff retention can be problematic [10]. An SME may also find it more difficult to influence the supply chain and demand variability [58]. Implementation frameworks for SMEs exist [see 61–64]. However, these are limited as they present lean as a project that implements tools via external expertise, which is an outdated paradigm within the broader lean literature. The frameworks are weaker at representing organisational culture and leadership [18]. These weaknesses also appear in SME implementations [65] with the struggles of management, human aspects and know-how [66]. Overall, research addressing lean in SMEs is scarce [58].

In summary, there is a need to examine further why lean implementations fail; including investigating the relationships between the methods or tools, the human factors, knowledge management, and situational specific problems including resource constraints. The latter is specifically relevant to SMEs.

3. Purpose and approach

3.1. Research aim

There is the need for a better understanding of the qualitative and human factors that affect the success of lean implementation. This is a question about the convergence of organisational purpose across all levels (executives, managers, professional staff, operators), and how culture, resources and personal agency intersect with the implementation journey. This is a complex problem because the variables are qualitative, there is no easy way to express the complex relationships of causality between the variables, the mix of organisational, regional, social and technical factors of lean change. The purpose of this work was to identify critical factors

for lean implementation, especially the needs of small to medium-sized enterprises (SMEs). This question is worth exploring for the potential to improve the effectiveness of lean initiatives.

The specific area under examination is small manufacturing firms, and the context is New Zealand (NZ). This organisational type was selected because there are unique challenges for these businesses to adopt lean, with their small size, challenging market conditions and diverse product mix.

3.2. Methodology

3.2.1. Multiple longitudinal case-study method

The research adopted an interpretivist method, embedding a researcher in longitudinal case-studies. The researcher was not naive about lean, hence this was a case-study approach as opposed to a grounded theory approach. Case studies have been used throughout the history of lean [see 67,68]. They have disseminated the Toyota Production System [1,2], defined lean [14,69], identified the factors for successful implementation [4], and developed specific applications [70]. The longitudinal approach is needed for eliciting the organisational behavioural factors, which are difficult to find with cross-sectional studies [71]. Multiple and longitudinal case-study methods are lacking in lean research [71] and especially for SME applications [58]. The approach followed recommendations of Flyvbjerg [72] and Thomas [73].

3.2.2. Design of the intervention

This study followed two lean implementations as longitudinal case studies. The approach was to embed the researcher as an industrial employee in each organisation for a set period. As this was a time-consuming approach, the study was limited to two businesses. The research was funded by a New Zealand Government grant. In each case, a research team member was embedded for 30 plus hours per week in the SME implementing lean.

The selection criteria for admitting a firm to the research were:

1. Being a local commercial firm that was involved in manufacturing activities – this was necessary to fit the manufacturing expertise of the embedded researcher. This reduced the potential confounding effect of organisations with different operational processes, and the risk of the researcher intrinsically knowing more about the production processes in one firm than in the other.
2. Having an active intent to implement lean or on a similar journey.
3. Were genuinely willing to host the researcher in a substantive role within the organisation, as opposed to merely being an observer.

Ultimately, the research set out to answer which success factor(s) for lean could be considered the root causes of lean success and failure. While the study was based in existing theory for lean implementation, the underlying research philosophy was an inductive and exploratory study where the observations from the two cases formed a mass of data for interpretation of the critical factors of implementation.

The first industry embedment was (case A) 24 months as the lean team leader for a high variety low volume (HVLV) manufacturer and a later technology tool implementation that lasted seven months. There was a follow up after a further six months with observations spanning over a total of four years. The second case (B) was a lean change management role for a business providing moderately customised products for the construction industry lasting 11 months with follow up 13 months after the embedment. These cases allowed a perspective to form of different situational factors and the practical challenges faced in an implementation. Observing

the two different cases permitted a comparison of the attitudes, approaches, behaviours and resultant outcomes.

Categorising lean according to different industry sectors can be beneficial, e.g. 'lean production' as opposed to 'lean service' [74] and other classifications [75–77]. However, it is arguable that the general lean principles, methods and challenges of change apply across sectors [3,78]. The particular cases analysed here handle HVLV production and could be classed as either production or service.

3.2.3. Characteristics of the selected case companies

Case A was a precision engineering jobbing shop in a struggling industry. Jobs were highly technical and employees highly skilled, but the company was struggling in declining economic conditions. The company had a flat structure of approximately 20 full-time employees. The company had positioned itself well in the marketplace, obtained highly skilled staff, and acquired extensive plant. Still, management recognised productivity was low and lean became a strategic priority. This study had two main periods, an initial 24 months embedment and a seven month ERP tool implementation.

Case B, a manufacturer of customised products for the construction industry, was followed over two years. The embedded researcher held a productivity improvement (change manager) position. Cases A and B were both make-to-order businesses with nominally 20 employees; however, B had a more standardised product and process. Company B did have better cash flow than A, but the effect of cash flow on management approaches was not apparent, because of a more frugal attitude in B's management. Also, B was in an industry that had a slight resurgence and was looking at an imminent industry boom for which they were motivated to prepare. Company A was primarily seeking to survive in severe economic conditions.

A significant difference was, while in A management had limited knowledge of lean themselves and delegated responsibility to an intermediate level, B employed an expert (our researcher) as they recognised they did not have the ability. The expert was still relatively new to lean but was positioned at a senior level and allocated time to study the business, learn manufacturing strategy, and given more authority to make changes and influence the company's direction than in case A.

Compared to other firms in New Zealand, these companies were relatively typical in size. In NZ 97% of enterprises have fewer than 20 employees [79]. Hence SMEs dominate the employment statistics and make a sizeable contribution to the gross domestic product. Having 50+ employees is considered a large firm in NZ [10]. Hence the sizes of the businesses examined here are representative of a large sector with NZ, and the findings may likewise generalise further.

4. Results for case study A

4.1. Operational culture

Human consequences of expediting invoices for cash flow

- Management pressured staff to ship and invoice as much as possible each month-end. This resulted in extreme expediting at month-end, which exaggerated the unevenness of work-flow, further causing decreased productivity (and therefore profitability). This damaged the establishment of lean principles including flow accounting. While similar problems occur when public companies fixate on maintaining their share price [70,80], the driver here was to increase cash flow in challenging trading conditions. The human consequences were poor staff morale, low job-satisfaction, poor individual productivity and difficulties with staff retention.

Typically half the time, the first week and last week of each month, were spent in inefficient expediting.

Poor operational planning - Management perceived that office efficiency was second to the factory where the physical production took place. However, the office was a significant restriction in the work-flow as one inefficient contract engineer would delay many more factory workers. Expediting work in the office in efforts to increase production resulted in hasty decisions and poor planning, and severe inefficiencies. Also, shortcutting the system meant relatively simple tasks took longer to correct. Ultimately, neither the staff in the factory nor the contract engineers in the office had time to work on improvements or new initiatives due to the inefficient practices and constant expediting.

Sales versus production - There was a higher focus on making sales through marketing than enabling the factory to be productive. However, marketing was more developed than production and could close more sales than the factory could undertake. Management would further bend to the customers' requests, fearing to lose them to competition. Hence, production was typically pushed to full capacity which added pressure and stress to employees. This resulted in decreased productivity and overall profitability.

Scaling factors - The company had in recent years grown from 5 to 18 employees, and as a result, the culture changed. Employees perceived more distance between themselves and management. This diminished employee commitment and resulted in disengagement from the improvement process, withholding improvement suggestions.

4.2. Lean implementation

Lean was pushed down from management to be implemented by staff, but the knowledge and resources to execute were lacking. The company sent a selection of team members to a two-day lean course and followed up with a series of lean videos¹ for the education of all staff. The course had little content for SMEs except questionable advice to ignore takt time [78]. The training stopped after that. Management verbalised improvement goals, and idealised 'The [A] Company Way', but successes did not materialise, and workers came to view the initiative as a fad. Staff meetings occurred monthly but the content was not vision inspiring nor did it give practical steps for the staff to proceed, but instead merely reported financial metrics. Time and resources were not provided to plan or make improvements. Employee resistance developed. Employees were never adequately engaged in the lean vision and treated it with contempt. In many ways, the operational culture described above and enforced by senior management opposed lean principles did not allow a new lean operation to develop. The result was that the company only achieved a minimal level of improvement (5S), but fell well short of implementing lean on a comprehensive scale.

4.3. Tool implementation (ERP)

Twelve months later, the company's lean implementation revived with a focus on enterprise resource planning (ERP). This was driven by the need to reduce the high administrative burden on the business. ERP is not strictly a lean tool, but when appropriately applied it can be used to minimise waste for a lean system. This case continuation was a further seven months embedment.

ERP had been a strategic priority for three years and had been in planning for two years. Throughout the implementation process, staff were provided with various levels of support. There was a regular two-hour weekly meeting that presented the vision, discussed progress, and addressed questions. They developed systems

¹ A series of videos by the Society of Manufacturing Engineers.

for recording common queries and standard works procedures. Support was readily available from the manufacturing manager and the ERP provider. Consultants from the ERP provider also assisted with site visits.

It was evident from the outset that a relatively small action could have a sizeable effect on an implementations' success. For example, a little comment from the accounts clerk, questioning the accuracy of the software, caused the managing director to insist on running the old system in parallel with the new through the entire financial year, halting the direct transition to the new system and creating enormous inefficiency.

Many employees were frustrated and voiced negativity. The sources of frustration observed included: not accepting the vision for the future state ('journey view'); not perceiving opportunities for personal development; not understanding the purpose; mistrusting the motives of management; catastrophising the individual outcomes. This caused resistance to change. Group effects also escalated negativity among members of one family which then spread to other employees before they even had the opportunity to use the system.

In some cases, staff struggled unnecessarily. A staff member was frustrated manually rounding time entries, but never thought to ask if the process could be automated. Another user struggled with icon size for months; a quick screen resolution change fixed it. Employees communicated in a regular interactive discussion that management provided but in many instances did not think to ask 'is there a better way?' Additionally, some employees were particularly afraid of making mistakes. This apprehension left them paralysed in their work and excessively frustrated.

Management prioritised staff engagement over technical effectiveness in some cases by implementing employee ideas that were otherwise unnecessary. For example, they unnecessarily duplicated redundant fields in the ERP databases and job sheets to show employee input would be taken seriously.

Over the following year, various changes with factory staff occurred which resulted in increased employee involvement. Some negative team members resigned. Resignations were partly due to chance but also due to the struggles coming to terms with the change taking place. The manufacturing manager moved his desk from the administration office to the factory; this supported the culture and engagement with his active presence. And functional groups held regular improvement meetings which preserved the momentum of change.

Over time, employees became more familiar with the ERP system and could see its benefits. Team members previously opposed to the changes began to comment positively regarding how their work had been improved by maintaining the flow of information and eliminating the duplication of data entry. They also could see the potential for further improvement.

4.4. Summary

The firm's first attempt at lean implementation failed. No one in the organisation truly understood how to gain the benefits of lean and an existing operational culture that opposed lean principles was not changed. The firm revived its lean attitude with an ERP implementation. This caused them to engage the employees in an ongoing improvement process, and management learned to work alongside the employees.

5. Results for case study B

Preparation period – building lean knowledge

The first phase at company B was a preparatory immersion in the business and its processes. The change manager (researcher) was involved in all aspects of the business to understand it and its

value proposition; this included time spent working in the factory, in administration, and contacting customers. Basic processes were mapped, and initial gaps in the purchasing and logistics systems were filled, standardising job information flow. This standardising of processes laid the foundation for future improvements. These fundamental improvements were made while the researcher built an understanding of lean and the business context.

The development of the change agent's knowledge was a key component of case B. Through self-study this manager's understanding of lean developed, and his concepts adjusted. He went from merely seeing the five principles of lean [3] to understand the need for enduring change and organisational learning. Four texts structured this education. First, *The Goal* (Goldratt & Cox, 1984, 2004) gave concepts of flow. Second, *Lean Thinking* [3,20] introduced lean principles. Third, *Staying Lean* [4] opened the view of sustaining lean with organisational development. And fourth, *Switch* [81] expanded his knowledge of change leadership.

Mapping the business processes identified areas in dire need of improvement. The clear understanding of core processes also established the vision for change. As improvement areas were very evident, the process-map could be quite simple. Higher level strategic planning was carried out in conjunction with the process mapping. They utilised a qualitative analysis of strength, weakness, opportunity and threats (SWOT) with consideration of political, economic, social, technical, environmental and legal (PESTEL) factors. An outline plan for implementation developed. First, educate senior team members in regular management team meetings to build a guiding coalition. Second, define value in the eyes of the customer, create the urgency for the change, and develop the vision including a presentation to the employees as a whole. Third, establish regular staff meetings that build a continuous improvement (CI) culture. Finally implement methods in the factory, beginning with simple visual management (5S) in the office and workshop.

5.1. Implementation

The change agent progressively educated senior team members on flow thinking, visual systems, building healthy habits through standard work, and the benefits of staff engagement and employee initiatives. He illustrated the present state of the business as a water system with bends, leaks, unnecessary junctions and build-up of waste and began to work on improvements with team members.

Invoicing every day was a simple habit that when implemented in the management team improved throughput in the business. This pull system exposed problems in other information areas, which had not been evident before. Simple visual systems were applied to Office work in progress (WIP). Rather than hiding files in cabinets, the outstanding invoices and quotes were made visible to all. Additionally, they implemented a simplistic form of Takt to preparing quotations. The firm on average did 60 quotes in a four week month. These were each different sizes, however, if every workday the estimator prepared three quotations on average then tender deadlines were consistently achieved and resource demand was levelled. The documents for quotation were arranged in priority order and displayed visibly such that the Managing Director could see if the estimator was on target.

The production office implemented 5S and standard work. They monitored progress on goals with a kanban board. A regular monthly review and report to management acted as higher level PDCA. A short weekly management meeting was established for communication among the management team and was used to impart lean knowledge and provide regularity for the implementation.

After the senior team had a fundamental education, a short (15–20 min) weekly staff meeting was instituted to cover gen-

eral business needs and generate a culture of improvement. This meeting was used to develop staff and give them an opportunity to express any concerns to management, ensuring employees felt involved in the company. Over a few weeks, the staff vision for change and their identity developed, before the introduction of lean methods. Thus the program for change did not start with an improvement event but by slowly introducing the concepts and developing a staff identity that engaged them in continuous improvement.

The goal of the first staff meetings was to, in a simplified way, introduce the concepts of lean and begin to change the way the employees think of themselves and how they could contribute to the business. Employees were asked to think of themselves as 'Improvement Engineers' to build their attitude of engagement and initiative taking. This new title given to them is similar to the 'Inventor' example in *Switch* [81], it reinforced the desired behaviours in a new employee identity. A welder was not just a welder, but a Welder & Improvement Engineer and a driver, not only a driver but a Driver & Improvement Engineer. They also gave an example of a simple improvement, adding a tick box on a job card. There was an excellent response to the new concepts. Staff immediately approached management with ideas for changing factory processes and dealing with old stock.

The second week a visual presentation was used to develop in staff an intuitive appreciation of the programme. The vision was supported by an emotion grabbing visual. A timeline was laid out on the table. A cake was used to represent the workload increasing day by day. Cupcakes represented the workload from Day 1 to 4. Following that, a day X illustrated the pending industry boom by a giant chocolate cake. The example successfully engaged employees, with this vivid, tangible and edible illustration.

Problem-solving and PDCA with A3 management techniques were introduced slowly in these sessions, based on simple problem solving with 5 Whys. The manager stressed how an improvement idea should be something from those on the factory floor, i.e. a change the employees recognise would benefit their work. Care was taken to keep these meetings short and not overload employees.

In the fourth meeting, employees formally registered as improvement engineers. The registration form appeared as a contract that described the role and required a signature. This reinforced the new identity and seriousness of management and was something for employee résumés. An opportunity for improvement (OFI) form was also provided to enforce the recognition of staff ideas with a system.

The above process continued to reinforce ideas and develop employee participation in problem-solving. The implementation was supported by observation with management by walking around (MBWA). This was essential to see the real state of the factory, the gamba, where value generation occurs, gain regular feedback and build relationships with the employees. 5S activities were conducted in small teams, and weekly PDCA was applied. The team leaders began to show more initiative in leading change and employees were encouraged to find solutions to whatever frustrated their work.

Most staff engaged well, but a level of persistence was required. For example, a kanban style planning system experienced resistance. The change agent had to run the system initially, while other managers objected. It was decided not to proceed with the board even though employees were not engaged. The employees could not visualise how the system would work and could not realise its benefits until it had been running. Ultimately, the primary opposition to change was departmentalisation. The accounts department found it difficult to accept the interrelatedness of the whole. They desired to optimise their systems not recognising the effect on the whole flow of information. A feeling of seniority based on age and

perceived experience contributed to the account departments resistance. It was also difficult for the management team to accept there was expertise amongst the workshop staff and the benefit of discussing improvements with those doing the work.

Two additional concerns were the on-going education of management and tendencies of tampering. First, regarding management education, an informal rudimentary training was given to the management team, and each was gifted a copy of *The Goal* [82]. Some read this book and were inspired to learn more, others did not. Second, administration staff tended to tamper with systems unnecessarily. As the systems were integrated, the office administrators got overly frustrated when employees failed to adhere to the new systems. Rather than allowing time for employees to learn the system, there was an inclination to quickly put in additional controls, tampering with the system, without analysing the root cause.

The researcher's embedment as change agent lasted 11 months. During this time, he had been slow to take the initiative with the factory, lacking confidence and clarity in the approach. This meant the factory workers were not actively involved until six months had passed. And only four months were spent working with the factory employees. Some have stated three years as necessary for a sustainable lean culture [20,83]. Once the expert left the organisation, the office manager took over the change agent role. A *Company Production System* document was developed to help educate employees in lean from the context of the specific organisation and in the weeks before departure, the change agent withdrew, meaning some other staff automatically took up more responsibility, showing ownership of systems and their development. The company had basic tools for continuous improvement and the influence of the Improvement Engineer program. The company did come into the expected boom period for its industry in the following year, and developed further systems and procedures as the business grew. It was evident that the implementation could have achieved more if the change agent had remained active in the company. He had developed a high level of lean knowledge and given time would have incorporated that into the business. The remaining management was slow to pursue new knowledge.

6. Discussion

These two case studies highlighted key issues in handling staff and their resistance to change, but undoubtedly, the progress made in case B was more than case A. Minor differences between the businesses studied were discussed and particularly the challenges faced necessitated skills in the application of organisational leadership, lean techniques, engagement, and education.

6.1. Critical factors for lean

Many of the critical success factors for lean implementation were observed in the two cases. The outcomes agreed with the literature on lean [20,46,47,55,70] and contemporary models of change management [39,81,84,85]. These deal specifically with the needed leadership attitudes for a sustained change as opposed to taking lean as mere methods [16,36,86]. These are well summarised as strategy and alignment, leadership, and behaviour and engagement which is necessary to enable the tools, technology, and processes of lean [55].

The following specific factors were influential in the success or failure of lean in the cases studied:

- Fragmented implementation strategy: Case A resulted in an implementation failure associated with later waves of resurgence. Management possessed good intentions but lacked the persistence to understand and implement lean in a holistic sense.

This was not the fault of commitment in itself. They desired improvement but rather than having regularity and a focus on staff development and continual improvement there was a fragmented approach to implementing lean with poor follow up on initial activities.

- Limited resources for SMEs: The challenging market conditions for case A inhibited the development of a lean business system and hindered productivity and profitability by staying with existing practices. The trust in lean was insufficient to break out of the old habits. Notably, there was also little advice available to them as an SME with their specific operating conditions.
- Resistance to change: Lean methods were well selected, but there was high resistance from staff. Their resistance was founded on a lack of individual knowledge, and strengthened by group effects. Staff did not understand the tools and couldn't visualise the benefits. Negativity bred negativity, and a growth mindset was missing.
- Employee Identity: The implementation in case B utilised an improvement engineer programme. That programme purposefully set out to change the employees' identity, installing a growth mindset while also showing the company's seriousness at involving employees. Employee Identity can be leveraged for the success of lean implementation.
- Employee engagement: Additionally to the development of the bespoke improvement engineer programme, employees were engaged in lean by vividly presenting the vision and need for change. This resulted in an implementation that did not merely focus on process improvements but also sought to engage staff in problem-solving. Although there was still moments of resistance, there was much more engagement with employees than case A.
- Persistence: The challenge of organisational change highlighted the importance of maintaining engagement. Some changes were implemented not because of their benefit but because it was a step, acknowledging staff initiative in suggesting improvements. Lean methods themselves need to be selected not only with a view of their immediate impact but also with a view of long-term organisational development.
- Confidence: In case B the confidence of the change agent was a factor for success. Lack of confidence and hesitation would likewise be a cause of failure, that is not taking the 'leap of faith' to lean and being comfortable with minor process change, stuck with status quo and the way work always was done. Case A, in essence, trapped within status quo, lacked the confidence to change, e.g. not allowing time for improvement initiatives.

The experience with the case studies specifically permitted new insights to be gained about the pivotal role of the manager's knowledge, and these concepts are developed in the next section.

6.2. The effect of the manager's knowledge

The outstanding difference between case A and case B was the time allocated to learning. Company B did not discover any particularly new methodology. Their approach was extracted from readily available texts [4,20,81,82] and applied in their context. In contrast, case A inadvertently neglected fundamental matters because management did not have an adequate understanding of the change or an up to date knowledge of the methodology. In their minds, they knew what lean was, but their understanding was in fact short. They broke the principles of lean and neglected matters crucial for organisational development. They did not allocate adequate time for improvements which includes time for their education along with that of their employees.

Knowledge about lean sustainability exists, and the proofs of its benefits are widespread. Lean's benefits are advertised in manu-

facturing and service industries, now being applied in universities and the general public sector [76,87,88]. Although more work is needed, basic knowledge on how to have a sustained implementation has been available in book form for nearly a decade [20,47] as well as through the rise of many internet resources [89]. But, the question that lingered throughout the research was: Why do managers (1) not embark on or (2) embark on a substandard, tool focused, and unsustainable lean implementations?

Previous research has correlated exposure to lean information with management commitment, and in turn, linked management commitment to successful implementation [90]. However, the many failed instances of lean indicate that if the knowledge does, in fact, exist (at least in part), it is underutilised. So, it appears that the primary answer to why managers do not embark on or embark on substandard implementations lies in inadequate knowledge and further a passivity among these leaders towards acquiring new knowledge.

The results of a lean implementation are directly related to the knowledge of lean possessed by those designing and executing it. This is particularly true because of the customisation needed with lean. The design and execution, including the way management handle strategic and cultural aspects, is based on this knowledge. Therefore, the level of success and sustainability are strongly related to it. The manager's personal understanding of lean is a critical factor in the success or failure of an implementation. Their knowledge, gained by training and experience, is in effect the basis for which they make decisions regarding the strategic direction and development of an enterprise.

Taking knowledge as a critical success factor is in line with Edward W. Deming's system of profound knowledge [91]. Applying the Deming system would imply the lean manager needs an appreciation of the system, the theory of knowledge, the psychology of change and understanding variation. This profound knowledge is vital in lean generally and potentially more so in SME implementations due to potential attrition of key staff. For lean, leaders initially need a proper and accurate understanding of how lean would benefit their specific business. This, in turn, should install a desire to learn more about lean and its implementation. This base level could be accomplished by addressing (1) the lethargy or apathy to lean by generating the desire and willingness to learn more about lean with the goal of obtaining its benefits. The learning that follows would begin to address (2) the basic understanding of the lean system. However, the difficulty is to properly advance the knowledge of lean beyond a superficial appreciation of tools and methods to (3) an adequate or profound knowledge of the strategic and cultural aspects of lean, as well as the specific organisation's systems and the psychology of change for its transformation. This higher level of understanding is critical in the design and execution of a successful, sustained implementation.

The literature emphasised that management commitment is vital to lean success [12,55–57]. But the real key to achieving lean success might not be management commitment but understanding to what management should commit. Management should commit to knowledge and learning as emphasised in these cases. The many failed instances of lean implementations may be due to managers' attitude to lean knowledge and having a low understanding of lean, its benefits, and its implementation. Two basic levels of misunderstanding, are conceptualised in Fig. 1. The first level of ignorance results in absolute failure of the implementation, i.e. no implementation. At this level, first, because many managers' are ignorant of the benefits, they neglect lean and do not consider it a strategic priority. Second, if they have heard a little of the benefits, they may not have the adequate knowledge to begin to implement lean. And third, even if they have a little knowledge of lean, this knowledge is most likely out of date, and they do not implement lean because they do not have the adequate understanding. This

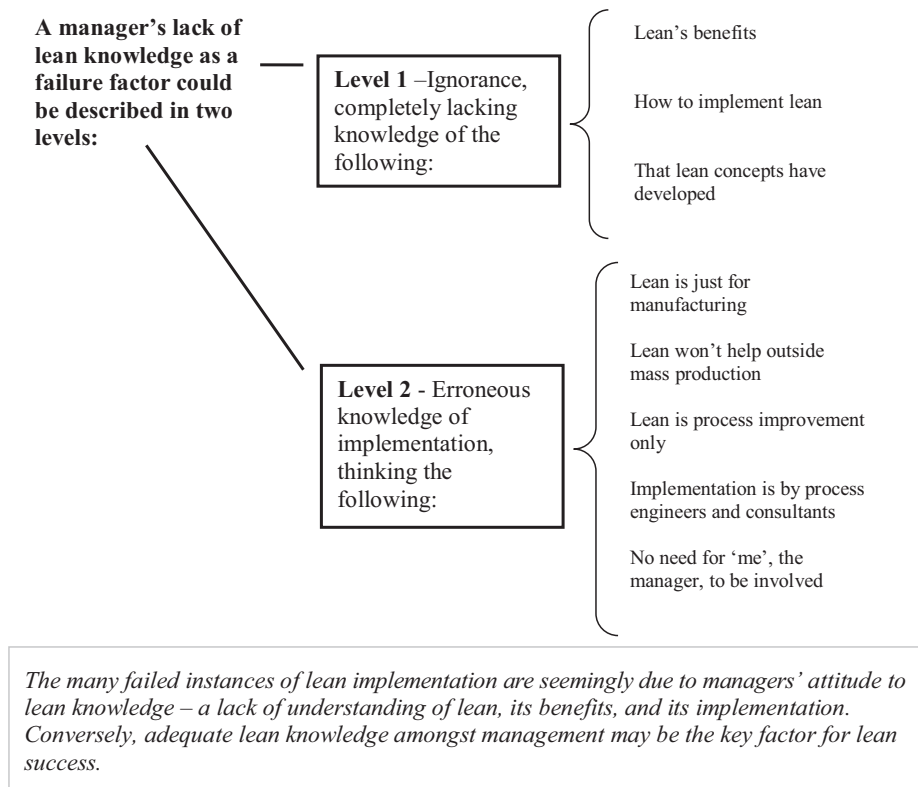


Fig. 1. A manager's lack of knowledge as the overriding (root cause) factor for the failure of lean implementations.

is closely linked to the second level of misunderstanding, an erroneous knowledge of implementation. That is, there may be errors in their knowledge, they may feel that lean won't help their particular case; e.g. considering lean is just for manufacturing, specifically mass production. Finally, as observed in this study, managers' may think of lean as only process improvement, seeing its prominence as tools and techniques but not a culture of employee engagement. Therefore, they embark on a methods only approach to lean. In this way, they neglect social aspects for sustained change and continuous improvement. As a result, managers' taking the easiest path, delegate the implementation to process engineers and consultants, not realising the need for their personal involvement. Because of this, there is a high likelihood of poor decision making, through delegating responsibility without discernment. This, in many cases, results in inappropriate delegations to process engineers and consultants who themselves may or may not take a suitable approach to lean (most likely the latter). In the meantime, due to their ignorance, senior managements' actions may negate any gains made.

The cause for managers' neglect of new knowledge is unclear. Regarding the cultural context, this research was conducted in New Zealand, where others have identified this attitude [92,93], including interview sources (Pers. Com. Joiner, Gardiner & Reaney, 2011).² It is possible that geographical or cultural conditions amplify the disregard for new knowledge. But it seems more likely due to the way lean has developed over time. The similarities seen between lean and other methodologies may give senior managers an attitude of 'we have seen it all before' and 'it is just a rehash of JIT,

TQM or other methodology' (ref. Case A). Because of the similarities, mainly seen in the tools, it is easy for leadership to miss the significant developments in lean over the last 20 years. The consultants many who have taken a tool approach and for years have left a multitude of unsustainable instances of lean do not help these perceptions. It is believed that senior managers, not realising the full benefit of current lean thinking, respond slowly (if at all) to support lean. Interview sources suggested that senior managers (especially SME owner-operators) feel they can continue, as usual, picking and choosing amongst the lean tools. Unless supported by government funding, these managers are not likely to invest in consulting and training [92]. For SMEs, this is a particular concern.

6.3. Model: entrance of lean knowledge into the SME

For an SME the managers' knowledge may be especially critical. Fig. 2 proposes that the major entrance way for knowledge into small businesses is through its management. Although new and motivated employees, along with a variety of other sources, may bring in knowledge, the primary entranceway would be through the leadership, as depicted by the larger arrow in Fig. 2. It is true that hiring and training other employees brings in knowledge, but except for chance, this is the result of the employer understanding enough to recognise the value of the new hires knowledge. Large firms have systems and staff that, besides bringing knowledge, can be deployed to drive and sustain an implementation. But SMEs lack the dedicated resource and internal skills. An SME CEO illustrated this in the below discussion board comment.

'Our challenge in small business is that the same principles apply as if it were a large business, i.e. financial, marketing, strategy, quality, lean management etc. but the resources and therefore approach is different.'

² Interviews conducted in 2011 by Antony Pearce with Dean Joiner, business specialist, New Zealand Trade and Enterprise Better by Design - 28 years' Experience at Fisher & Paykel and with Ken Gardiner, New Zealand Trade and Enterprise Lean Programme Manager and with Nigel Reaney, Managing Director LMAC Consulting Ltd, 12 years' experience with the establishment of Toyota UK and their European training branch.



Fig. 2. Entrance of knowledge into an SME. Proposing that lean thinking is accumulated and retained predominantly at the management level.

Staff attrition worsens the situation for SMEs. Employee training develops internal capabilities, but they can quickly move on to opportunities in larger firms [10]. In addition to the attrition of general knowledge, their experience within the particular organisation is lost. This kind of tacit understanding takes much time to develop and is difficult to codify for others to reference. Lean systems develop to suit the operating characteristics and culture of an organisation. The extent of documentation required to document such tacit knowledge is enormous and difficult to achieve in the constraints of a small business, however also potentially devastating to enterprise efficacy if it leaves with a staff member. Hence, in an SME it is particularly important for management to own the profound lean knowledge for continued success.

6.4. Maturity of implementations

The above factors would be expected to have a universal effect on the progress or maturity level of SMEs in the context of implementing lean. Various models of maturity level and self-assessment tools have developed for lean [94,95] and highly related methods [96–99]. These typically assess how processes themselves have developed and neglect the human/social aspects [100] and tend towards an episodic view of change. However continuous and emergent change is required for a maturing lean implementation [101]. Overall the literature reflects that it seems there is a slower uptake of lean in SMEs [58,102] with the vast majority of implementations focused internally [103]. The reluctance to assign resources to lean and short-sightedness regards operational culture observed in case A confirm these tendencies along with generally slow maturing of organisation A, requiring several attempts at becoming lean. Case B made progress at a much more significant rate but then also slowed immensely once the change agent and source of lean knowledge departed. Future research could compare maturity levels of organisations over a large sample and identify the factors that support or hinder maturity. An appropriate measure of the embedment of organisational learning would need to be developed, incorporated and given adequate emphasis amongst process maturity measures.

Maturity models also imply a specific pathway for an organisation, but one approach may not fit all. It is essential to consider which methods are most suited to the overall development of the business rather than just being a quick fix or high impact method [42]. This has been covered in detail elsewhere with a lean risk assessment matrix [34]. It gives specific examples of SMEs and emphasises cultivating lean culture over quick-fix methods.

6.5. Implications for practitioners

Management knowledge of lean and the development thereof needs active consideration in the implementation phase. For a permanent transition from existing traditional practices to lean practices, an understanding of the attitudes and behaviours necessary for lean success is critical. Managers may prefer to delegate responsibility for implementation to a consultant or another employee, but even the selection of and direction given to delegates needs the basis of an adequate understanding of what lean success requires. The transformation of lean is systemic, relating to the whole organisation and the way it behaves. Therefore if leadership does not own the lean knowledge, potential benefits will most definitely be stifled by existing, opposing or traditional philosophies (like conventional accounting methods). The managers' delegation of responsibility also becomes dangerous as they do not understand what is needed to lead the change.

6.6. Implications for future research

Researchers need to define the critical success factors of lean more explicitly; including the specific management commitments. This study identified managements' knowledge as a determinant of the success of an implementation and suggests it may be the critical factor in implementation success or failure. This observation needs further confirmation and clarification which can be achieved by analysing the relationships between managements' knowledge, implementation success (performance measures) and the other factors identified in the literature. Further, it is essential to explicitly identify what aspects of lean knowledge are most crucial to its success. As the literature has already identified the various critical factors, quantitative research methods can now be used to rank the relative importance of these known factors and measure the correlations between them and performance. This will begin to identify more explicitly what managers need to commit to when they commit to lean.

The emphasis on knowledge indicates that the effect of the competence and ability of leadership, employees and consultants is significant. This implicates the *resource-based view* [104], where knowledge is viewed as the preeminent resource of a firm [105] as well as the importance of deliberate learning [106]. These need further investigation in the context of lean.

6.7. Limitations

The primary limitation of the study is that it relies on only two case studies. While two cases is an improvement on the typical single case cross-sectional survey [71] it still limits the ability to generalise extensively. This includes generalising the size of an SME, which is categorised differently by country [10]. For example, an SME of 100 employees will behave much more like a large business than an SME of 20 employees. The work here was theory building and needs further empirical work as outlined in the research implications above.

7. Conclusion

The original purpose was to understand better the success factors for lean across all levels of an organisation (executives, managers, professional staff, operators), and how culture, resources and personal behaviour intersect with the implementation journey. This work shows how critical it is for practitioners to understand both the technical and social aspects of lean.

This paper provides new insights into the role of knowledge as a causal factor in the successful implementation of lean, especially in organisations with limited resources. These case studies

underscored the necessity of developing lean knowledge. The positive effects of lean knowledge were seen. The enlarged understanding became the wisdom for successfully implementing change. The organisational challenges faced by the embedded researchers' necessitated particular skilfulness in the application of organisational leadership as well as the lean techniques. This includes how to form the vision for change and present that to others, educating them and motivating them to take steps towards its goal. Managers' knowledge is defined here as *the knowledge based on which a manager makes decisions regarding the strategic direction and development of a business*. Knowledge became the wisdom needed to handle the many challenges of leading an implementation. Conversely, the lack of knowledge was highlighted as a key hindrance to success, and therefore a failure factor, resulting in managements' focus on the methods and improper delegation of responsibility, neglecting the important social aspects of lean and its implementation. Therefore, the root-cause of lean success may be simply leadership knowledge and therefore specifically the attitude and commitment of leadership to learning. This is opposed to the general view of management commitment, that is merely committing to lean as a strategic objective that others should achieve on leaderships' behalf.

These outcomes are particularly significant in SME implementations. While small organisations tend to have simple systems which promote flexibility to change and dissemination of knowledge, large firms have more systems and staff numbers that bring in knowledge and can be deployed to drive and sustain an implementation. SMEs resources are scarce and their processes often complex. An SME may also find it more difficult to influence the supply chain. Senior managers in SMEs, in particular owner-operators in small firms, may find it especially challenging to break old habits and dedicate time to learning. They are potentially blinded by their prior knowledge and feel they can continue business as usual, merely experimenting with some lean tools. There are SME implementation frameworks in the lean literature, but they tend to focus on lean as a series of methods implemented via external expertise. These miss or do not adequately stress the necessary organisational culture and leadership. The reality for SMEs is that due to the resource constraints and staff attrition in SMEs, it is especially vital that top management are the ones who possess the profound knowledge of lean to reap its benefits.

This paper makes several original contributions. The first is methodological, in the application of multiple longitudinal case studies to lean in SMEs. The second is identifying the importance of the knowledge of leadership in the success of lean endeavours. Third and conceptually, the importance of identifying what management commits to when they commit to lean, specifically learning and lean knowledge as opposed to merely the imposing of process improvement and lean methods. And finally, how retaining and developing leaderships' knowledge is critical, and especially so in resource-constrained organisations, like SMEs.

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