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Department of Labour  
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# Anatomy of Lean Thinking in New Zealand Workplaces

Case Study of Pacific Aerospace Limited

# **PACIFIC AEROSPACE LIMITED**

## **Introduction**

Sitting alongside Hamilton Airport, in what from the outside has the appearance of old air force hangars dating back to post second world war (and that is what they are) Pacific Aerospace proves to be a surprise in more ways than one. Not only are they a successful manufacturer of very smart small planes that excel in remote locations, they are also an emerging exemplar of a company successfully adopting lean thinking.

The visual contrast between the somewhat dated outward appearance of the hangers and the spick and span interiors couldn't be starker. Having visited hundreds of factories over the years I cannot recall being more impressed with the shine, colour and meticulous order, and a sense of a great working environment. It feels more like a model factory than a workplace, yet people are working away, talking, and, as I drove out, singing together lustily (and in tune) to a song on the radio station.

## **Profile**

Pacific Aerospace (PAL), in its various incarnations, has over 50 years experience designing and manufacturing rugged and reliable aircraft.

They have manufactured over six hundred aircraft ranging from the CT/4 two seat military aircraft trainer to the Fletcher FU-24 and Cresco agricultural aircraft which average up to 17 cycles per hour, to today's P-750 XSTOL (for 'Extremely Short Take-off and Landing') which is setting the benchmark in utility, skydiving and aerial survey roles around the world.

The company has grown from approximately 100 staff at the end of 2006 to now over 150 staff and is vertically integrated from the aircraft design and certification, machining and forming of metal and composite components through to the assembly of the aircraft and its systems and test flights.

PAL is part of a group of companies which provide a wide range of services from design and manufacture to aircraft maintenance, leasing, service support and even aviation insurance.

Its forebears started producing parts for Fletcher top-dressing aircraft in the 1960's. Full manufacturing started in the late 1960's with production of two lines of aircraft, peaking in 1975. Pacific Aerospace Corporation was formed in the 1980's to carry out manufacturing of aircraft. It was then purchased by an Australian company, and during this period the company manufactured parts for both Boeing and Airbus, until it was sold to the New Zealand based Aeromotive Group in 1995 when it began a renaissance.

In 2006 its assets were purchased by a consortium including Oceania Aviation Ltd. Since January 2007 Pacific Aerospace has lifted production of the XSTOL by 42% and

continues to ramp up. New markets include Indonesia, Papua New Guinea, India, Nepal and Latin America.

### 3. Pre-lean state

In 2006 it was a different story. There had been redundancies as orders dropped (staff numbers dropped to 100 at one point) and the 'doors had almost been closed'.

*It was almost terminal with no work and rock bottom morale. (Alf McLaughlin, GM Production)*

The production system was back-logged with lots of components being produced but very few sales being made. Managers who were there at the time report that:

*The company was run like a dictatorship, people turned up, did a bit of work and went home. No other contribution was asked for or allowed.*

The CE at that time is quoted as saying:

*If you don't like it you know where the bus stop is.*

This resulted in what was described as: 'an awful regime full of negative individuals with poor trust between managers and staff and between managers'.

Work areas were described as 'caves' and there was a culture of people hoarding and hiding tools from workmates.



**State of play pre-5S**

The change of ownership and the arrival of the current CE, Damian Camp, could not have been more timely.

The CE was appointed by the new owners and spent the first 18 months of his tenure trying to stabilize the company from a position of being virtually bankrupt. With little background in manufacturing he worked quickly to understand the business. He moved to establish new credit lines with major suppliers to free up working capital, and began to open up communication lines between departments, and with staff, as well as beginning to build a new management team.

He quickly determined that a clear and key goal was to increase manufacturing capacity so as not to keep customers waiting, yet he wondered how. He knew he had to get the business into a stable condition so that any new initiative could gain traction and not be sidelined by managers being too busy fire-fighting:

*It was about making sure no big hairy monsters leaped out in the midst of introducing change.*

He also knew that to introduce a new IT system or 'some other big thing' at this point would be a disaster.

Eight months in he was approached by New Zealand Trade and Enterprise (NZTE) who wanted him to join their '20 Keys' programme which he declined because the company wasn't ready for it with too much 'house keeping' still to be done. NZTE came back some months later with a suggestion that he go through Skills4Work who introduced him to lean thinking specialist Clinton Yeats. Damian went to a workshop run by Clinton and was immediately 'sold'. He then took two key managers to the second session and they bought in immediately.

## **Getting Started**

The first step was to engage a senior leadership team (SLT) in Clinton's training programme—a five day workshop-based introduction to lean concepts and tools with a fortnight for practical application of learning between each session. In particular the training focused on the responsibilities of managers in introducing and managing lean thinking. One immediate benefit of this programme was the forging of a unified, trained and focused group of managers who could see the potential application of lean thinking at Pacific Aerospace. Lean within PAL was also given its own identity and christened PACE or Pacific Aerospace Competitive Edge which has given everyone a sense of ownership. This has proved to be the critical success factor.

In the course of their training they produced a high level value stream map, displayed it around staff notice boards and invited anyone and everyone to identify issues, problems, and suggestions. Coming out of their training, there were two strands to the approach to lean they adopted: firstly to focus on setting up an 'Opportunities for Improvement System' (OFI) and secondly to progressively implement 5S in all work areas.



**Part of main visual display board showing OFI spreadsheet and plotting the prioritisation of opportunities for improvement.**

### **Opportunities for improvements**

The motivation for emphasizing the OFI system was to demonstrate to staff that if they had an idea, or were frustrated with something, it could actually be sorted out. In the context of the company's recent history this was hugely significant.

Suggestions coming from the floor were, and still are, routinely passed onto the OFI Management Committee which meets every three weeks. While starting off slowly at first in the face of worker suspicion, ideas and suggestions began to flow once people saw what was happening to their ideas. Each idea was considered, prioritised, and either adopted, pushed back for further clarification or declined. The real difference was that the initiator of the idea received a full response and explanation—proving for the first time that staff could effect change. Every suggestion and action taken was recorded on the notice board for all to see, and the initiator had the satisfaction of seeing their suggestion implemented

Damian quickly saw the power of this system as a means of establishing improved communication and accountability and underlined its importance by assuming responsibility for leading the OFI committee:

*It is not until the team see that what they suggest is seen, properly considered, taken seriously, and implemented, if practicable, that they will believe. (Chief Executive)*

## 5S

A pilot Performance Improvement Team (PIT) also commenced training with Clinton Yeats while the SLT was in the midst of its own training. It focused on the fuselage area of the operation and included staff from up and downstream of that work area.

To some of the team leaders, the PIT seemed initially like a distraction and a number of staff who participated were given a hard time by their peers:

*A lot of guys were nervous and quite resistant—they had always done it a certain way. Some of them gave me a hard time and said 'it isn't going to work. We have seen it all before. (Aircraft Fabricator and member of Pilot PIT)*

However, the original PIT members persisted because they were concerned about the loss of their jobs. They were also heartened by the unusual sight of managers:

*Getting involved, mixing it up, involving people, especially in the OFI's, giving out information, training up—suddenly managers were real people you could communicate with. (Aircraft Fabricator)*



**Pre-5S workstation on the left; the same workstation post-5S on the right.**

This in fact represented the big circuit breaker and was probably the most profoundly important moment in gaining real traction. In addition, the SLT allowed people to work overtime to undertake their initial 5S work. Building in time for lean work has remained important, although managers acknowledge it will be more difficult as demand for aircraft continues to grow as their industry emerges from recession.

Secondly when changes in the fuselage area began to take place such as tidying up the work area and placing tools and consumables (materials needed in production) close to hand in each work 'Cell', people began to 'turn'. They saw that change for the better was in fact possible and made life easier.

The first PIT was successful and also resulted in some staff moving to a different work area which had positive flow-on affects: 'It just happened...' (Aircraftsman in Fuselage area).

One of the biggest gains for staff was in placing tools at point of use. They used to have a tool room where tools were issued by a storeman. People used to hoard them, based on a lack of trust between staff, so that tools were available when they were needed. Now they have closed the tool room and have all necessary tools on shadow boards in each work Cell. They also operate a tag system so that whenever a tool is being used the user places a tag where it normally hangs:

*This has saved heaps of time and hassle—everything is within 1-2 meters of work and looks good. Tools don't go missing and are better maintained and the tool guy has been released to work on the floor. (Fuselage Aircraftsman)*

In addition, consumable parts that also used to be collected from the storeroom are now delivered to work stations and topped up on a regular basis.



**Mobile parts 'supermarket' right next to workstation replacing old stores setup that people spent hours each day going to and from.**

The interaction between the SLT and the Pilot PIT in their early stages is also seen as particularly important: 'Being able to speak our mind without fear of repercussions was huge'. Is is part of the training programme design developed by Clinton Yeats

aimed at identifying and ironing out communication and other issues that impede effective management/staff interaction.

The only gripe people from the Pilot PIT had was that they were unclear for the first two sessions about why they were there which made it difficult to explain what they were doing to other staff back at the workplace. Having a clearer explanation of their purpose and perhaps being able to show a DVD to non-participants that explained the key concepts may have made life a little easier.

## **Rolling out**

Lean has now been rolling out at Pacific Aerospace for over two years. Most work areas have now been trained and gone through a 5S process. Workers note that: 'It is well accepted in all work areas now'.

'Before and after' 5S photos are viewed as being most powerful along with 5S Boards in each work area that keep track of 5S audit results. One of the SLT members—the Production Manager—has responsibility for ensuring 5S continues to evolve. Team leaders now refer to 6S with 'safety' being the extra 'S'.

In the eyes of senior managers: 'The guys now own the workplace.' Bit by bit they have made many small changes that have transformed both the appearance and effectiveness of the workplace. As noted in the introduction, the pride of the workforce in their pristine workplace is palpable.

Both staff and managers recognise that there is a challenge in maintaining momentum with 5S after the early and more dramatic gains have been made.

There was some quite entrenched opposition from sections of the workforce at the beginning. However, the SLT steadfastly followed Clinton's advice and focused on working with the willing rather than pandering to or trying to win over those opposed. It is interesting to note that some of the biggest opponents of change are now leading improvement projects, according to a number of production workers.

The OFI system has so far generated 351 suggestions for improvement. The numbers are now dropping off as all aspects of production improve. New OFI's, including those from the shop floor, now come in the form of quite detailed business cases backed by research and cost-benefit analyses. People are now discouraged from submitting an OFI without also including a potential solution. Further, managers are keen to pass over responsibility for implementing a good idea to the person who came up with it. Some of these projects have resulted in the purchase of new tools and equipment, however, over the last 10 months or so proposed improvements that cost money have been less likely to proceed due to the economic recession.

In reflecting on this system the CE observes:

*The OFI management system was the key to grasp when faced with the 'shut-down' culture that permeated this place. People who had been ignored suddenly found they were listened to.*

### **Makeover of Plant 3**

One project of major significance involved staff and managers clearing out an old and decrepit building, gutting and painting it, and designing the layout of equipment and workflow to create the most efficient flow of parts in what is a much smaller building now known as Plant 3. Everyone can now see exactly what is going on at every stage of that part of the production process. This had been preceded by an analysis arising from a VSM of how a part traveled through the system. They found that it traveled 1.9km at walking speed and, given there are over 2,000 parts per aircraft, calculated that over 4,000 km were walked by staff in the making of every single plane.

In addition their VSM revealed that a significant number of non-critical parts went through the same heat treating and hardening process which meant the part had to wait for four additional days to allow the test pieces to be checked for hardness before the part could proceed to the next process. They discovered that most of these parts had never failed in 14 years and so they have now eliminated this waiting period for that category of part and it continues in manufacture and the test pieces catch up with it at final release.

They also designed more built-in quality assurance checks by the operators that have led to 1200 parts of a non critical category being checked by the operators/team leaders at time of manufacture and not stock piled for checking at a later date. This was assisted by differentiating between critical parts and non critical parts. All parts that were transferred had no NCR (or reject) history.

These examples highlight the seemingly small but significant changes arising from the detailed attention to work processes provided by a PIT team that includes staff from up and down stream of the process under review. The combination of those with detailed process knowledge and those with fresh eyes and an internal customer or supplier perspective has proved very powerful. This is also why 5S audits include people from other work teams:

*The improvements we make are subtle not dramatic, but the results are quick and have a big affect. Little things count. (Team Leader)*

## ***Training***

About 15 staff are currently gaining their Level 2 qualifications in Competitive Manufacturing. Staff see this as reviving the concepts they have learned and refreshing their awareness, all of which will contribute to sustaining lean at PAL. In addition, team leaders are progressing through leadership training aimed at enhancing their people management abilities. Both of these programmes are now entrenched.

In addition, the team leaders are developing a skills matrix for each Cell that is going on notice boards so that the mix and spread of skills can be seen by everyone, and who needs training in what to provide adequate cover for the team is clear:

*It used to be that skills were hoarded. Hidden knowledge is no good it has to be available to all.*

## ***Leadership***

A number of comments have already alluded to the critical factor of leadership in bringing lean thinking to life at PAL. The unity and focus of the SLT forged during initial training laid the foundation. Their determination to pay attention to the detail of work processes and to involve staff at every turn in doing so has been critical.

Workers have certainly noted that:

*Having management on board was critical. This requires time, effort and cost. Management rocked the boat and got it started and are still pushing it forward. (Aircraft fabricator)*

The attitude of managers to allowing time to work on lean and make improvements, undertake 5S audits etc is refreshing:

*To say you are too busy to spend time on this is nonsense. You are only 'too busy' because you are not working efficiently. (Production Manager)*

Perhaps the greatest act of leadership has been to open everything up to challenge. Removing hidden agendas and taking on 'sacred cows' has forced everyone to:

*Challenge everything around you—don't just do something because you have done it this way. (Team Leader)*

This represents a huge shift from conventional notions of management based on the separation of thinking and doing and managing by results. Staff acknowledge that 'this must have been hard for them'.

Interestingly, for staff, the way of working that lean has ushered in is now regarded as '....just common sense, but stuff that normally doesn't get attended to'. This

suggests that working in a lean way is a perfectly natural thing to do and is how things should work in any case.

The combination of this totally fresh approach to leadership, and the use of the lean tools and frameworks to enable change to be effectively managed, are transforming workplace culture from one of 'leaving your brain at the gate' to one of continuous improvement or process innovation.

Shop floor staff also are keenly aware that continued support from managers is vital to sustain the development of lean:

*If the leaders stop, everyone would stop as well. They would say, 'if they don't care any more, why should we.' We cannot take it any further than they are prepared to go.*

From the perspective of managers they see that:

*Addressing the frustrations of staff is the key. Some people are still tempted to work their way around a problem rather than address it properly but that door is now closed. Colin [Production Manager] has to sign off any change so people cannot patch over a symptom but have to do a Root Cause Analysis. (GM Production)*

A further act of leadership has been the deliberate decision of the CE to involve his Board of Directors. Part owner Oceania is now rolling out lean so a key owner has taken it on. The Directors have so far been very impressed especially in achieving such good results at no-low cost.

## Results



**Making fuselages in shiny 'new' workspace.**

The results to date from implementing lean at Pacific Aerospace come in many forms.

The cumulative effect of all the small and larger changes arising from the OFI and 5S process have added up to manufacturing capacity, the primary original performance objective, lifting from one aircraft being produced every five weeks to two being produced per month (from 10 aircraft per year to 24). This represents a huge productivity increase, achieved without any increase in staff numbers or capital investment. However, a reduction in demand during the recession has meant this level, which they hit for three months, has not been sustained and they are currently producing one aircraft per month 'although it feels slow for everyone' (CE).

The market is now starting to firm again so everyone is looking forward to being busier.

Another measure is that they cancelled a \$350,000 facilities expansion investment that had been approved but was no longer required because of the improved use of existing facilities.

They also achieved a 30% reduction in their general insurance premium as a result of moving out of a decrepit high-risk building into the much smaller Plant 3 that is easier to protect from fire and break-ins.

Quality has also improved with both customers and the Civil Aviation Authority of New Zealand's airworthiness inspectors commenting enthusiastically about the quality of the finished aircraft. Warranty claims are now few and far between.

Previously all capacity was geared to producing aircraft and there was no time left for maintenance. Now, with more capacity freed up, PAL can expand its revenue base by taking on aircraft maintenance contracts.

Team leaders report less waste and much more productive use of staff time. They also note the results of a recent staff survey which they say showed that:

- staff morale is positive
- people now want to come to work
- staff have stopped complaining about money
- staff would currently prefer some new and better tools than receive a pay increase.

These results are reinforced by a perceptible shift in community attitudes towards working at PAL. It used to be a place to avoid with high levels of staff turnover and difficulty in recruiting suitable staff. Now staff turnover is 1.2% per annum and PAL is reportedly regarded as 'an employer of choice'.

From an HR perspective the company reports:

*...a diminishing number of gripes and interpersonal issues. Also some of the biggest sceptics have become the biggest advocates. The most significant*

*improvement is the change in attitude and culture where staff are now taking ownership of a problem and resolving it rather than the previously prevalent blame culture. (Administration Manager)*

Four senior managers said that lean thinking has meant:

- a big reduction in fire-fighting
- much less process failure
- far fewer conflicts to resolve
- the satisfaction of seeing production increase
- happier staff
- more constructive ideas and requests
- a vast improvement in communication.

Echoing these comments are those of Damian Camp:

*...but culture change has proved the most rewarding. Engaging with the team on the shop floor, while still not 100%, has improved out of sight. Most are keen and willing to contribute and their contribution is recognised.*

Perhaps herein lies the biggest achievement: PAL have unlocked a formula which is creating a culture of staff/management engagement via effective communication. This culture is embedding continuous improvement that will put them in good stead to keep moving forward and successfully confront whatever challenges lie ahead. Interestingly, this emphasis implies a good appreciation of the philosophy and culture of lean ('know why') rather than just the tools and methods ('know how') which many western companies have tended to focus on.

Staff have been given control of their workplace and through the frameworks and tools of lean thinking have a structure for engaging on a common agenda of business development in the way that makes sense and works for all parties.

### **Maturing into sustainable lean**

Pacific Aerospace has been working away on lean for over two years now. They have enough experience of 'doing it' and seeing the benefits to know that this is an indispensable way of working that they fully intend to stick with. This is reflected at all levels:

*The guys don't want to let the good changes slip back. Keeping up with the 5S audits keeps forcing you to sustain the effort. (Aircraftsman)*

Team leaders for their part are confident that the systems are in place and working: 'The 5S audits run themselves now, people also clean up without being asked, and it doesn't take much time to get a response to an OFI' (Team Leader).

They also note that most 'beefs' have been dealt with and that apart from 5S audits and the occasional OFI, most change will now be driven by specific improvement projects.

Staff, team leaders and managers all note that there are challenges lying ahead in keeping lean fresh and dynamic. However, in their favour are the lean tools and management systems that are slowly building continuous process improvement into the everyday work culture of Pacific Aerospace.

### ***Opening the door to business development***

Damian Camp and his GM of Production Alf McLaughlin are now discovering that as lean thinking becomes embedded new opportunities to develop the company can now be explored.

To begin with, as the CE observes:

*Lean removes all the noise and inefficiency and enables us to spot where we need to place new technology in the knowledge we have already taken out most of the waste. This fine-tunes our investment decisions. It also enables us to introduce new technology more carefully so that there is less disruption, better understanding of the technology and how it fits and consequently a much quicker ROI [return on investment].*

These achievements are substantial given the angst most managers and staff experience in introducing new technology. In many instances there is little understanding of up and down-stream consequences of new technology or even if it is really needed.

The CE has also found that there is more time to engage with suppliers who do lean which provides a common language for dealing with each other in. They are also starting to look at other suppliers with a view to seeking a better alignment between the company's requirements and the supplier's service and quality standards.

Having focused to date on production and quality assurance issues attention is now turning to the design office. Damian is keen to build lean into the design teams work practice and later into their actual design work.

Beyond that more time is being freed up to invest in market development. The company is also exploring how to run two assembly lines in parallel as demand increases, thereby enabling the more flexible deployment of teams.

So after an initial heavy investment of CE and GM of Production time to establish lean, the elimination of time wasting on inefficiencies has in fact created more time to capture a broader range of benefits capable of propelling the company to new levels of performance.

Such widening of focus beyond simply getting the product out the door creates the potential for genuine business transformation—a factor that might be of interest to policymakers in an economy characterised by small to medium sized businesses producing relatively low value-add.

It certainly appears in PAL's case that lean thinking provides the means to get work processes under control and at the same time create a culture of workforce engagement, and in so doing frees up managers from 'fire-fighting' to focus on the many other aspects of business development and expansion. Lean is not everything but it clearly lays a necessary foundation on which further developments can be built.

This broadening of focus doesn't mean that the CE has taken his 'eye off the ball':

*I am always checking on notice boards to see how the OFI system is progressing and there is regular reference to PACE in all my communications. We also maintain our key leadership focus on it. PACE is not going to go away.*  
*(CE)*

## **Reflection and advice**

Preparedness for taking on lean thinking was a theme developed by Damian Camp. Having the business in a sufficient state of readiness is really important:

*You have got to have the business in a stable enough situation because it cannot work if you are constantly fire-fighting. The CE has to be available and hands-on to lead by example. You also need a clear reason that everyone can see and believe. It is very hard to do this properly if you think you are doing OK.*

The Chief Executive cited other critical success factors.

- The CE has to be focused, in constant support and prepared to keep shaking things up.
- The discipline and processes in place to carry on once the initial burst of activity and enthusiasm is over.
- To have management champions in all key areas of lean, including a 5S champion on the floor to keep on driving the change ('Change doesn't happen by itself').
- Lots of openness and communication is essential.
- There is a lot of work to fit in so you need to create time and space so it can be delivered.

Damian also advises that you need to take on a provider you are very comfortable with. Enthusiasm and the experience to quickly diagnose issues and give the right advice are important. Damien says that the heart and soul of lean is welcoming ideas from the shop floor: '...if you don't think this is a legitimate source then lean won't last'. He offers further advice:

*Nip 'naysayers' in the bud rather than giving them centre stage.*

*Explore all ideas at the front-end. There will be something behind them no matter how daft they originally sound so apply RCA. After a while the quality of the ideas will improve hugely as people get used to it.*

*The CE needs the backing of the Board for what is a long-term change. If you don't believe in this yourself, don't bother trying. If not sure, leave it until you are, because if your staff get enthused and you don't follow through you may never get another chance or at least will face a huge wall of resistance.*

Damian, and in fact everyone I spoke with, is a believer in the Pilot PIT running in parallel with the SLT training which they say is a great vehicle for ironing out the communication issues between managers and workers in a way that connects managers to the realities of work processes (and the frustrations they bring) and staff to a whole of business perspective.

Damian suggests:

*Wouldn't it be great for New Zealand if lean became mainstreamed at the top? If John Key started talking about lean regularly it could transform workplace productivity in this country.*

The CE's final reflection is that: 'We have a long way to go here at PAL'.