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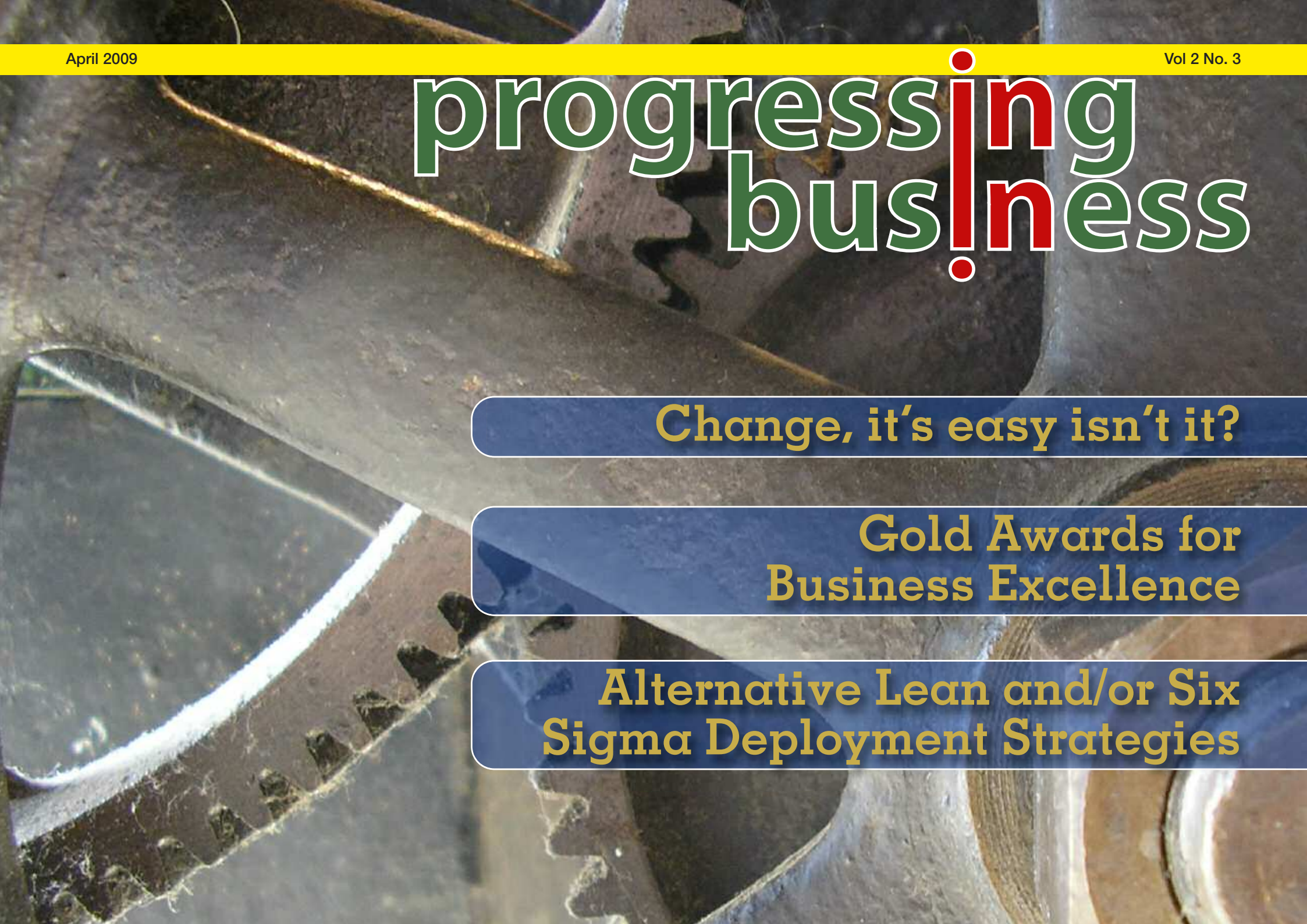

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Alternative Lean and/or Six Sigma Deployment Strategies

Alternative Lean and/or Six Sigma Deployment Strategies

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KEY WORDS

BB	Black belt
BPR	Business Process Re-Engineering
DMAIC	Define, Measure, Analyse, Improve, Control
GB	Green Belt
KPI	Key Performance Indicators
LSS	Lean Six Sigma
LSS+	Lean Six Sigma Plus
LSSL	Lean Six Sigma Light
MAIC	Measure, Analyse, Improve, Control
MBB	Master Black Belt
MRP	Materials Resource
ROI	Return on Investment
SME	Small and Medium Enterprise
TL	Traditional Lean
TPM	Total Preventative Maintenance
TQM	Total Quality Maintenance
TPS	Toyota Production System
TSS	Traditional Six Sigma
YB	Yellow Belt

INTRODUCTION

Organisations in Australia are either deploying a traditional six sigma model originally developed by Motorola in 1987, have adopted a traditional Lean model or a combination of the two referred to as Lean Six Sigma (2003).

Some organisations are still leveraging off the previous quality and continuous improvement initiatives like Business Process Reengineering and TQM (Hilton, 2008). Some Small and Medium Sized organisations are simply focused on the continuous improvement strategy within the ISO9001 framework using regular Kaizen events or implementation of the PDCA methodology.

In Australia, evidence of these deployment strategies can be seen from the following:

- Government based initiatives like the Innovations Insights program

- The membership of the Australasian Association of Six Sigma Practitioners
- The membership of the Association of Manufacturing Excellence
- Federal government Workplace training courses in Competitive Manufacturing
- A number of Lean and/or Six Sigma conferences
- An increasing number of Lean and/or Six Sigma Training providers
- Existence of many advertisements in www.seek.com.au

However, the factors critical to a successful deployment have only been reported anecdotally mainly at Lean and/or Six Sigma conferences. Specifically, factors critical to a successful deployment have not been empirically tested for Australian organisations, nor has the drivers of the deployment been evaluated.

Using case studies in Australia, we compare the different deployment strategies of Lean Six Sigma. The differences can be seen in one or more of the following ways:

1. Belt infrastructure in place is different (all or only some levels for MBB's, BB, GB and YB)
2. DMAIC phases vary from the use of simple and complex tools, eg Lean focused in the improvement phase; Variations to Six Sigma tools used in the Measure and Analyse phases
3. Deployment and program mainly facilitated by external consultants/trainers rather than internally
4. An organisation-wide philosophy or a project driven approach

Further, the factors critical to a successful deployment are also uniquely different for Small and Medium Sized Enterprises (Antony et al., 2005), Rowlands (2004) and (Wessell et al., 2004).

LITERATURE REVIEW

Empirical evidence in the academic literature, for example, (Antony et al., 2002); (Lee et al., 2006); (Antony et al., 2005); (Hariharan, 2006); (Antony, 2004); (Antony et al., 2004); Knowles et a (2004); (Williams, 2006); (Caldwell, 2006) suggest that the factors critical to a successful deployment include the following; no matter which one of the deployment models have been deployed.

1. Leadership commitment
2. Continuous improvement culture
3. Competency based training and assessment
4. Effective teams
5. Effective measurement systems

As stated above, the factors critical to a successful deployment are also uniquely different for Small & Medium Sized Enterprises (Antony et al., 2005), Rowlands (2004) and (Wessell et al., 2004).

Deployment of Lean Six Sigma has developed considerably over the last 2 decades since Motorola deployed its initial Six Sigma system in 1987. For Motorola, there were no green belts, black belts or master black belts or champions or any of the infrastructure or focused training we have come to associate with modern practices in Six Sigma. What most people do not realise is that, in addition, to its Six Sigma initiative, Motorola had a secondary initiative to reduce cycle time. However, the cycle time reduction effort did not use the lean tools or structure we use today. During Motorola's first five years of Six Sigma deployment, there was no formal MAIC training, let alone formal lean training.

In 1991, Motorola's Six Sigma Research Institute developed and delivered Motorola's very first BB and MBB training using the MAIC model. In the mid 1990's GE added the define phase, Allied Signal added the champion infrastructure and GE Capital brought a strong focus to Voice of the Customer and integrated DMAIC with the BPR model of Hammer (1994) and Brache et al (1995).

Also during the mid 1980's the Toyota Production System (TPS) was gaining popularity among traditional manufacturing companies as they responded to Japanese competition. TPS was an improvement philosophy embraced by all employees.

In the mid to late 1990's Six Sigma and lean systems tended to be viewed as separate and distinct improvement methods. Today most organisations have begun to integrate Six Sigma and lean along with project management and BPR (George, 2003).

Mader (2008) in *Quality Progress*, a practitioner journal suggests that the deployment model of Lean or Six Sigma or Lean Six Sigma can either be Traditional Six Sigma, Traditional Lean, Lean Six Sigma Plus or Lean Six Sigma Light.

TSS was introduced by Motorola's research institute in 1991 but was not widely practiced until 1999. TSS was implemented in Allied Signal and GE and other large organisations in the US. Mader (2008) suggests that TSS effectively integrates each of the Body of Knowledge for Six Sigma, BPR and project management. It has also been effectively tailored to financial services, healthcare and other specialised industries.

LSS+ is used when the objective is about flow of work rather than quality of work. This model provides flexibility in problem solving and economy of scale in deployment costs. Under the LSS+ model champions and MBB's determine the type of problem under consideration and then determine the method best suited to the problem in terms of time, cost and quality. If a Six Sigma approach is warranted a project is launched under the traditional DMAIC model. After the analysis phase is completed, the Champion and BB could decide that lean tools might provide a more effective solution.

LSSL model entails use of the DMAIC structure, a limited set of Six Sigma tools (tending towards the simpler ones) and the mainstream lean tools like 5S, Value Stream Mapping, TPM, Visual Workplace, Error Proofing and Quick Changeover. LSSL method might not be well suited as a general method for solving all problems in operations, but it has a definite benefit when applied to smaller scope projects under a Kaizen philosophy. Generally the length of the DMAIC cycle is less than for the TSS model. The main drawback to this approach is that when we encounter a problem that cannot be readily addressed using lean or the basic Six Sigma tools, the solution tends to be a band-aid. We end up putting in place a sub-optimal solution that might necessitate further improvement efforts in the future.

TL is the traditional lean model involves the tools from the TPS approach. This is useful when applied systematically to repetitive processes involving flow of material, transactions or physical product. Under this model there may not be any belts leading the projects but rather could be lean practitioners.

The tools used in each phase vary considerably across companies and projects. There is no standard set.

Six Sigma methodology was developed by Smith (1991) and Harry (1998). The phases of the methodology are represented

by DMAIC or Define-Measure-Analyse-Improve-Control. Sections of this DMAIC methodology appear to be closely aligned to Deming's Plan-Do-Measure-Improve continuous improvement cycle (Pyzdek, 2003a). The actual tools and techniques used within the stages of applying the methodology can vary by the users and it would be important to examine the different approaches to each phase.

Most practitioners and researches refer to the five phases above but Harry and Schroeder (2000) expanded this methodology slightly to an eight-phase approach. The eight phases are:

1. Recognise needs and requirements;
2. Define levels of entitlement;
3. Measure actual performance;
4. Analyse capability and capacity gaps;
5. Improve systems, operations and processes;
6. Control key inputs;
7. Standardise methods and procedures and
8. Integrate improvements and knowledge.

Since Harry and Schroeder (2000), most authors have used only five phases. For example, Hahn et al (1999) suggests that the stages are:

Define - this relates to appropriate selection of projects, problem definition, and defining the metrics with their baseline and entitlement (optimal) levels.

Measure - select the appropriate responses (the "Y's") to be improved, based on customer inputs and other considerations (such as product yield), ensure that they are quantifiable, and that we can accurately measure them. Determine what constitutes unacceptable performance (ie, a "defect"). Gather preliminary data to gauge current performance.

Analyse - analyse the preliminary data to document current performance (baseline process capability), and to begin identifying root causes of defects (i.e., the "X's", or independent variables) and their impact, and act accordingly.

Improve - determine how to intervene in the process to significantly reduce the defect levels. Several rounds of improvements may be required. Recently, special emphasis has been given to reducing variability.

Control - once the desired improvements have been made put a system into place to ensure the improvements are sustained, even though significant resources may no longer be focused on the problem.

D	**Define the goals of the improvement activity.** At the top level the goals will be the strategic objectives of the organisation, such as a higher ROI or market share. At the operations level, a goal might be to increase the throughput of a production department. At the project level goals might be to reduce the defect level and increase throughput. Apply data mining methods to identify potential improvement opportunities.
M	**Measure the existing system.** Establish valid and reliable metrics to help monitor progress towards the goals defined at the previous step. Begin by determining the current baseline. Use exploratory and descriptive data analysis to help understand the data.
A	**Analyse the system** to identify ways to eliminate the gap between the current performance of the system or process and the desired goal. Apply statistical tools to guide the analysis.
I	**Improve the system.** Be creative in finding new ways to do things better, cheaper, or faster. Use project management and other planning and management tools to implement the new approach. Use statistical methods to validate the improvement.
C	**Control the new system.** Institutionalise the improved system by modifying compensation and incentive systems, policies and procedures, MRP, budgets, operating instructions and other management systems. Documentation systems such as ISO 9000 can be utilised to assure control.

Table 1: Phases of DMAIC from Pyzdek (2003a)

By way of comparison Pyzdek (2003a) suggests the five phases can be represented as in table 1.

Deployment in SME's is also different according to Antony (2005), Rowlands et al (2003) and Wessell et al (2004).

Antony et al (2005) found that Six Sigma was generally not popular among SME's. Their final analysis studied 60 SME's that responded out of 400 and found that:

- 35% of respondents using Lean Six Sigma had no project champion
- One company has a MBB
- 80% use only Green Belts
- 19% were using design for Six Sigma
- 6% were using Lean Six Sigma
- 6% were using Six Sigma and design for Six Sigma

Wessell et al (2004) suggest that Six Sigma need to embrace the following deployment approach to be successful for an SME:

- Every single project has to contribute positively to the bottom-line.
- Projects need to be closely tracked
- A training program to ensure cultural uptake
- Only one Black belt
- An understanding of process management strategies
- Use of consulting services that are modular in form
- Adjust Six Sigma to ISO9001/2000 to allow automatic certification

Rowlands (2004) suggests that the traditional Six Sigma approach to black belt training and deployment is not desirable in the case of SME's.

Waxer (2004) concludes that the following factors are critical to success in deploying Lean Six Sigma. They are:

1. Management team buy-in and support
2. Education and Training
3. Resource commitment
4. Link to compensation

Spanyi et al (2003) have identified the following key elements for a successful deployment in an SME:

1. Clear definition of customer requirements
2. Shared understanding of core business processes and the critical characteristics
3. Rewarding and recognising the team members
4. Communicating the success and failure stories
5. Selecting the right people and the right projects

CASE STUDIES

For the following organisations, semi-structured interviews were undertaken with senior Lean Six Sigma facilitators. Drivers and deployment strategies were discussed.

1. Multinational manufacturer (2)
2. Small & Medium Sized (SME) manufacturer (2)
3. Hospital (1)
4. Bank (1)

In one case a questionnaire was completed by a number of senior managers and factors critical to a successful deployment were analysed statistically. For other cases, action research is the research methodology as the author is involved in lean and/or six-sigma training in these organisations.

Case 1
SME Manufacturer – Action Research

- 75 on staff
- Deployed Lean over 2 years with DMAIC projects recently added
- Trained 13 team leaders to the equivalent of Yellow belt level
- Interviewed Operations Manager – passionate about improvements and expects the same of his senior staff; is coach and mentor to the team leaders through the 2 group leaders
- Automotive first tier supplier
- Key driver is international competition and the continual need to push costs down and transfer margins to customers
- Continuous improvement is part of the company culture through push by Automotive customers
- Chosen not to employ "Belts" as they are too "theoretical" as stated by the Operations Manager and need to be in the line management functions (not pissing into the tent from outside)

Case 2
Hospital – Questionnaire analysis

- 120 staff
- Deployed DMAIC awareness training to middle management only
- Key driver is government funding - If KPI's are improving then there is more money
- Sent a questionnaire to 18 senior staff asking them to rank factors that could be a measure of a successful deployment of DMAIC – the performance measure was timely, accurate and equitable access to outpatients
- The critical factors are tabulated in table 2.

Case 3
Multinational Manufacturer – Action Research

- 120 being trained to yellow belt
- 3 green belts
- Previous history of quality improvement strategies
- 5S implemented but faded away
- Using Lean with DMAIC projects
- External trainers
- Key driver international competition
- Performance and share price extremely good because mining industry is major customer
- Training is funded via Government program

Open organisation - Statistically significant
- An open, trusting organisational culture is necessary for the hospital.
- Frequent use of cross-departmental and empowered teams is important.

Planning and values – not statistically significant
- Written quality values and/or mission statements are important.
- Aligning hospitals goals with staff development and actions is critical.

Training – statistically significant
- Training in Quality principles is important.
- Training in problem solving skills is important.
- Training in teamwork facilitation, structure, and action is important.
- General awareness training in performance improvement methodologies is important.

Table 2: Published in September edition of TQM, 19 (1)

Case 4
Bank – semi structured interviews

- Thousands on staff
- Green belts trained in their hundreds using a bootcamp philosophy, large number of BB and a number of MBB as coaches
- Significant investment in training but significant savings and reduced costs
- Drivers were
  - Six Sigma was combined with Lean since latter could not solve all problems and large-scale change program and perceived over-dependence on consultants for process improvement
  - The engagement model of forcing most Bootcamp attendees to have a viable project ready to commence before training is completed has greatly assisted in the overall success
- High touch coaching model (typically 2 to 4 days per week of coaching time for the first CommWay project in each business area) was key to the knowledge uptake of the project teams and success generally.
- A mandate the completion of a standard CommWay 14 week project before considering candidates for Green Belt training, and insist on Green Belt Certification before Black Belt training. There have been a few exceptions to this model, and we have seen less effectiveness of the trained team members in terms of number and success rate of projects than in the mainstream model
- The most important success factor is the practice of committing staff and sponsors upfront to the full project and having them demonstrate their commitment through investment in training and project time

Case 5
Multinational Manufacturer - semi structured interviews

- Large presence of "belts"
- Training suppliers
- Ex GE MBB facilitating program
- TSS deemed to be a competitive advantage

Case 6
SME Manufacturer - semi structured interviews

- Key driver was key supplier – do it or else!
- Green belt facilitator
- Training costs were restrictive
- Recognition and reward process was active
- Cannot afford to pick the wrong projects
- Voice of the customer super critical

CONCLUSIONS/INSIGHTS

- DMAIC prevalent no matter what industry, model
- Belt infrastructure more prevalent in larger organisations
- Training costs higher in larger organisations
- Critical success factors vary for SME's
- Recognition systems assist successful deployment
- Coaching a good follow up to training
- There is a variation in the training & assessment of Lean Sigma experts by training providers

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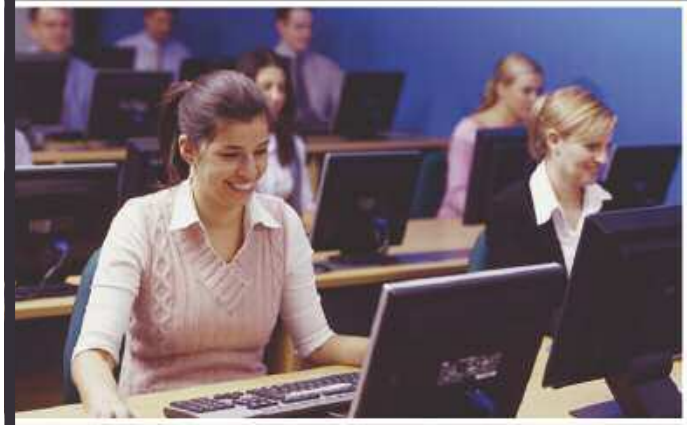

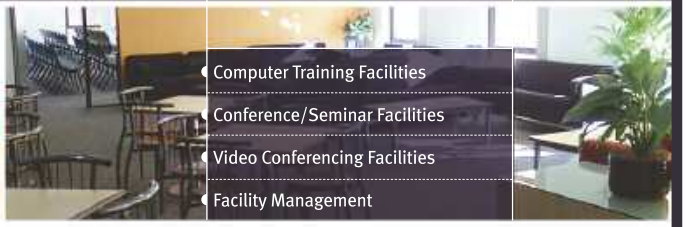

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