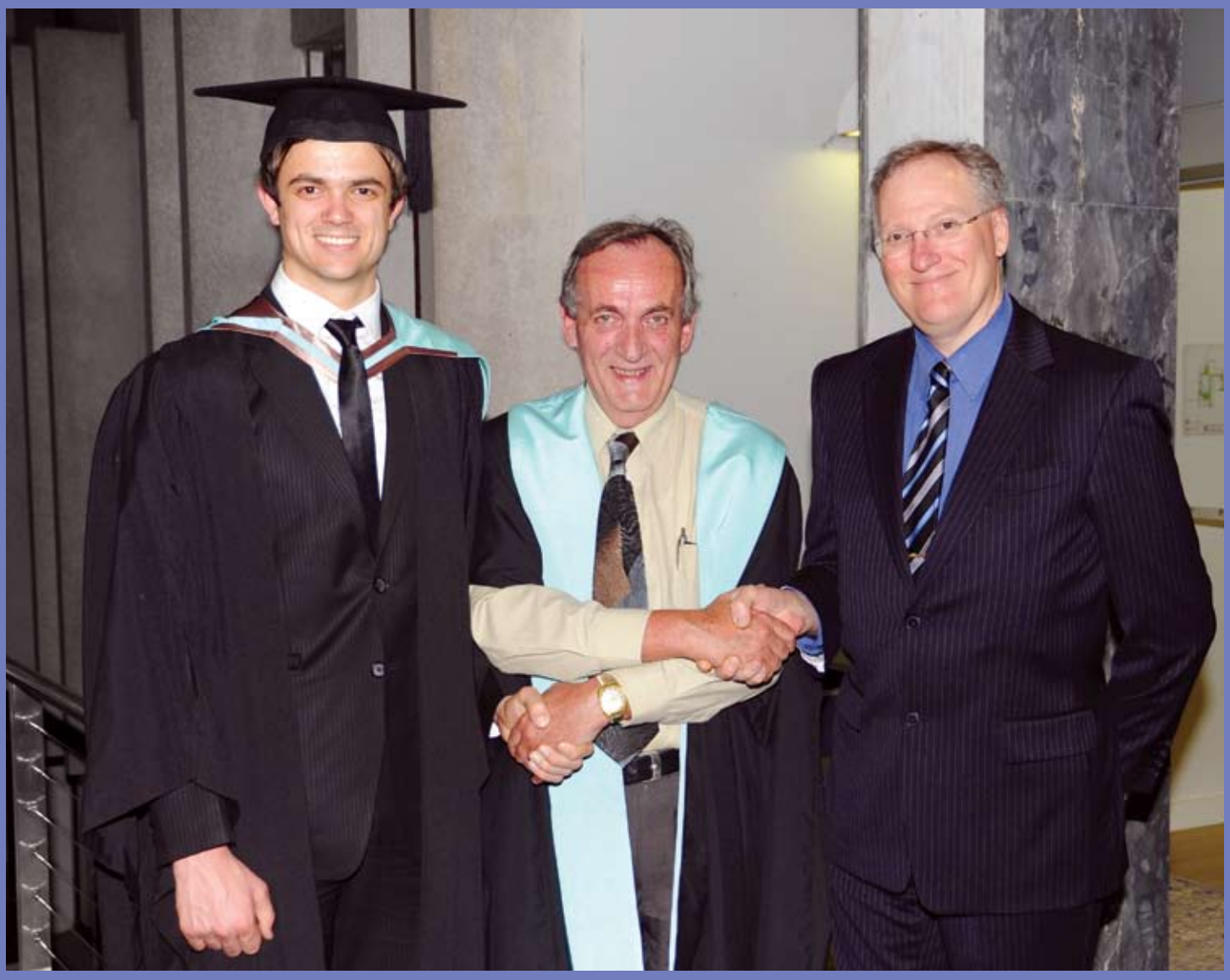
# New Engineer
## JOURNAL

*Servicing Manufacturing, Industrial Engineering and Engineering Societies*



## In this Issue



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Vol. 13 No. 2 October 2010

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# New Engineer Journal

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# Contents



**Front Cover:** Monash Engineering graduation ceremony at Robert Blackwood Hall, Monash University, October 2010. Daniel White, Damian Kennedy and Robert Ades.

**FORMAL PAPER REVIEWS**
Leading papers published in this Journal are usually fully refereed. This service is available through the **New Engineer JOURNAL**. Papers which are to be fully refereed for formal publication may be submitted at any time.

# A Little Something for Everyone...

This edition of **New Engineer** has something for everyone! It's what, I believe, makes this journal 'different'.

We have our usual informative set piece from IIE Federal President Daniel Kulawiec, a note on the formation of 'SIGS' and an introduction (or at least a photo of) newly elected IIE Directors Scott Fairburn, Bill Ferme and Sam Ghaith, together with a goodly mix of papers, reports and other bits and pieces. Also, we have a unique photo adorning the front cover of this edition of **New Engineer** – but, more about that later.

In his Federal President's Report, Daniel Kulawiec states that the IIE continues to remain in fine financial shape. However, he and other Board members would like to see a better balance of membership-representation from across *all of Australia*, and not so dominant from Victoria. Results of elections to office and other matters from the September, 2010 AGM are also reported by Daniel.

This edition includes a timely piece from Roger La Brooy (Roger is not only a fine academic but, obviously, also a cricket nut). His expose on the finer aerodynamic behaviours of spinning cricket balls is informative, rigorous and well researched. It should do well in warming us all to the imminent battle of "The Ashes" with the 'ol' enemy', the Brits. Personally, I can't wait to test Roger's thesis viewing, no doubt, many a super 'slo-mo' replay of spinner attacks.

Daniel returns (in the third over) with news that the IIE has launched a new approach to better engage with IIE members, and in the meeting of specialist professional needs. Special Interest GroupS (SIGS) are in the process of being formed with interest already expressed by Monash IE alumni and Manufacturing people wanting to form their own SIG. Scott Fairburn follows with a directive on how to do all this.

John Blakemore cannot keep away from the bowling and presents with a paper addressing the electronic-era integration of Lean and the Balanced Scoreboard. John sees the true and tried principles of lean logically (and digitally) supporting (indeed, if not informing) key performance metrics – as expressed in the widely used Balanced Score Card approach to the setting and achieving of organisational-excellence goals.

Finally, Bill Ferme finishes the bowling stint with an informative article on Small Business Mentoring. Bill's vast experience in this area sets the background to his paper and informs a caselett that proves most interesting to read.

To complete this innings, back to the front cover photo taken at the most recent Monash Engineering graduation ceremony at Robert Blackwood Hall, Monash University, October 2010. Aside the older, shorter (but better tanned) chap in the middle, is to my left Robert Ades and to my right, Daniel White.

This 'link photo' (aka "the bookends" photo according to the participants) is unique…Robert was the very first graduate of the IE program at Caulfield/Chisholm/Monash in 1984 and Daniel the final graduate (in alphabetical order) in 2010. Linking this is yours truly having started with the IE program in 1980, and thirty years later, finishing with the same program cum 2010. Truly a unique occasion…I hope you agree, to be celebrated and noted.

***Dr. Damian Kennedy***
***damian.kennedy@eng.monash.edu.au***

## *YOUR CONTRIBUTIONS ARE WELCOME*

Some Suggestions are:

- Ask the speaker at your regular member meeting for a copy or notes of his or her talk and send the draft to us to provide wider readership.
- Ask your colleagues for a written statement – long or short – which will inform or interest your fellow readers. Send some of your publicly available brochures and information kits to our editor for the information of your fellow members and to increase interest in your firm's products and services. Pictures are welcome: personalities, processes, plant and offices to show you are a positive developing unit within your industry
- Dash off an Email to us about your view of areas you would like us to include in **New Engineer** to stimulate industry improvement and innovation.
- See that someone is delegated at each plant visit to report on the visit for the benefit of fellow members in other states.
- Tell of success stories and policy statements of wider implication for our readership.
- Provide your personal observations from overseas visits and conferences, apart of course from your organisation's confidential data, to help readers keep up with the global economy

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# Institute of Industrial Engineers Federal President's Report

The 2010 Annual General Meeting for the Institute of Industrial Engineers was held in Melbourne on the 11th of September. This provided a great opportunity for the IIE Board to meet in person, as well as allowing Federal Councilors to personally meet with some of the Institute's members. In addition to the formal agenda, there was time to discuss issues that are both important to our members and the Industrial Engineering profession within Australia.

I am pleased to advise that the Institute of Industrial Engineers enters the 2010/11 year in a good state. Financially we remain well positioned, and we continue to attract new members (although we would always like to see the rate increase). The Institute produced some well received editions of our flagship publication '**New Engineer**' last year, and by the time you read this, our 2010 AGM will have been held. The AGM remains one of our key events of the year as it not only allows us to manage and steer the Institute into the future, but it provides a great opportunity for members across the country to meet and debate the current and future states of our profession.

I am also pleased to advise that, in addition to the re-appointment of Directors retiring and eligible for re-election, three new Directors were elected to council. Sam Ghaith, Scott Fairburn and Bill Ferme have joined the Federal Council. The three new Directors provide representation of a wider cross-section of members, and bring new views and skills to the Council. Additionally, these Directors directly represent both the Monash Alumni Special-Interest-Group, and the Manufacturing Special-Interest-Group. (See following article: Ed) This is advantageous as these two new groups of members are now directly represented on Federal Council.

In summary the full results of election of Directors and Office holders at the AGM are:

- Federal President: Daniel Kulawiec
- Senior Vice President: Robert Watson
- Immediate Past President: Dr Damian Kennedy
- Federal Secretary: Lex Clark
- Deputy Secretary: Sam Ghaith
- Federal Treasurer: Selvarajah Radhakrishnan
- Journal Editor: Dr Damian Kennedy
- Webmaster: Vacant (Daniel Kulawiec acting)
- Chairman Membership Committee: Lex Clark
- Membership Secretary: Scott Fairburn
- Promotion and Development Director: Bill Ferme

The Federal Council is aware that the current make-up of the council has a large representation from the Victorian division. This is not a sustainable position, and the Council is keen for a more uniform representation across the Divisions. It has arisen due to a lack of Director Nominations from outside Victoria. In order to address this situation in the future, the Council has passed a motion that will allow it to use some of the mechanisms within our Constitution to re-balance the Board over the next couple of years. However this still requires nominations from interested members who would like to take on a more leadership role for the Institute. I will be working with the Divisions during the year ahead to seek these nominations.

*New Directors (L to R): Scott Fairburn, Bill Ferme, Sam Ghaith*

The formal elements of the AGM covered reports from the President, Secretary, Treasurer and Membership Chairman. The Audited Financial Reports were also presented and accepted by the AGM and show that the Institute remains financially healthy. I am also honored to have been nominated for the grade of Fellow at the AGM for services to the Institute. I was pleased to accept this nomination.

The strategy for IIE to strengthen its role as the representative body for Industrial Engineers within Australia remains true, and I am pleased that the current Federal Council are keen to address this challenge.

I am keen to speak with as many members as possible over the coming year. If you have any comments or suggestions please feel free to contact me on the email address below.

*Bob Watson (R) Presenting Fellowship Certificate to Daniel Kulawiec*

Finally, I look forward to continuing working with all members of the Institute during the year ahead, and to further strengthen both IIE and the Industrial Engineering brand.

***Daniel Kulawiec***
***Federal President, IIE***
***daniel.kulawiec@bigpond.com***

# Conventional and Reverse Swing of a Cricket Ball

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## Abstract

Cricket is a game that has stirred passion of the sporting public in countries of colonial origin. The game is one of subtlety where understanding the aerodynamics of the cricket ball is paramount. Many studies have been conducted on the swing & reverse swing of a cricket ball by eminent aerodynamicists. This paper will place the findings of such work into a cohesive framework provided by the author and identify combinations of ball orientations giving rise to both types of swing. It will then report on the practice of reverse swing at an elite level and identify strategies to combat the effects of this type of bowling.

## 1. Introduction

Conventional swing bowling requires the presence of a shiny half of a cricket ball and a prominent seam on either a 2 or 4-piece ball. Conventional swing occurs normally over the first 20 overs or so of the life of a new ball. In order to explain the phenomenon, consider a ball with a seam that is angled anti-clockwise from the centre-line of the pitch. The batsman would see a 'non-seam' half and a 'seamed' half of the ball as shown in Figure 1. Conventional swing requires the shiny half to be present on the non-seam half for the ball to curve or swing in the direction of the seam. The seam then acts as a rudder. Figure 1 shows this orientation, termed an 'outswinger' where the seam points towards the slips when bowled to a right-handed batsman. For clarity, all diagrams in this paper will focus on this scheme of ball orientation. Seam orientation can be mirrored and ball orientation reversed about the pitch centre-line to achieve the opposite 'in swinging' effect.

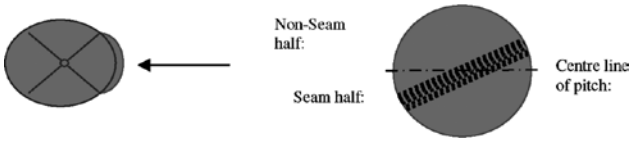



*Figure 1. Plan view of the batsman (left) facing a ball (right) showing a visual 'seam' and 'non-seam' halves of the cricket ball as seen by the batsman*

## 2. Some Crucial Preliminaries

The air film closest to the surface of a moving ball forms a boundary layer that can either be laminar (on a shiny surface) or turbulent on a rough surface. Curiously, turbulent boundary layers are more stable and tend to hug the surface of a ball for a longer circumferential distance. Turbulent boundary layers therefore separate 'late' as shown in Figure 2 shown here to separate at an incident angle of 135 degrees to the air stream. Figure 3 shows the apparatus used in the static trial and Figure 4 shows how the airflow can bend around one side of a spinning ball.

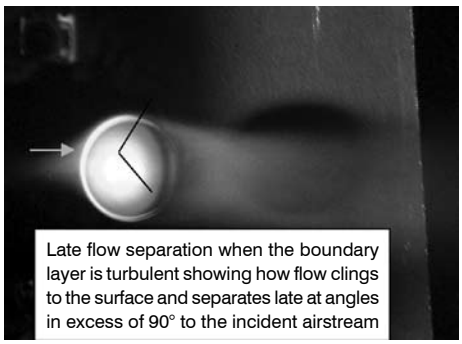



*Figure 2. Late separations of flow caused by turbulent boundary layers generated by the seam of the ball*

### 2.1 The Reynolds Number

The Reynolds Number is defined as:

$Re=Ud/\upsilon$ where U = ball velocity, d = ball diameter and $\upsilon$ = viscosity.

It is well accepted that if a constant Re is maintained, dynamic similarity exists between real life and the model particularly when the latter operates in a different medium. Use of Reynolds number similarity allows for velocity and geometric scaling. Hence when a large diameter ball is subjected to low wind tunnel air velocities, the situation is dynamically similar to real cricket balls bowled at high

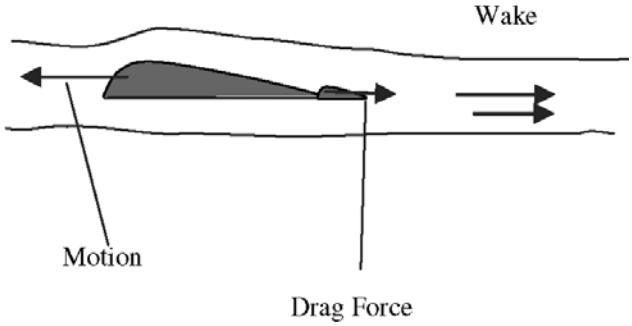



*Figure 3. Straight line motion*

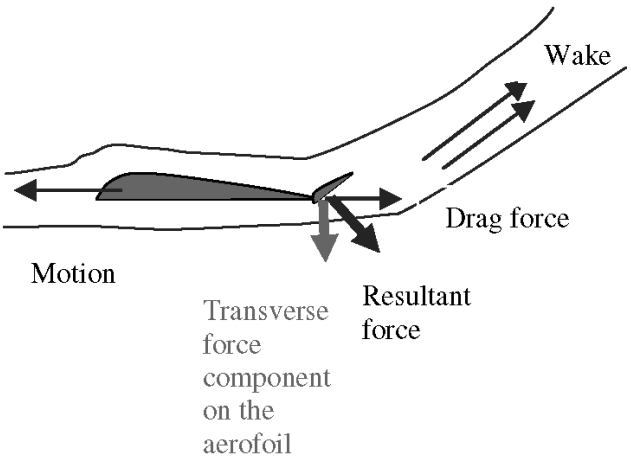



*Figure 4. An offset wake signifies the presence of a force (not shown)*

speeds. The clear advantage with using Reynolds number modelling is that lower experimental wind speeds in wind tunnels allow for visualisation of intact smoke trails.

Boundary layer transitions from laminar to turbulent occur at critical values of Re. The Reynolds number on the rough surface of an old ball is lower than for a shiny surface. For reverse swing, it has been shown by Mehta [1,2] that the transitional Re decreases with increasing ball roughness.

### 2.2 The Wake

The author postulates that the observation of wake direction indicates the direction of the force components to which an object is subject. This is central to the development of theories presented in this paper.

Consider the wake behind a simple aerofoil moving in a straight line as shown in Figure 3.

If the control surface is tilted, a resultant force exists on the aerofoil causing the wake direction to be offset upwards and to the right as shown in Figure 4.

Clearly the drag component of this force acts in a direction opposed to motion and **the transverse force** component acts at right angles to the motion and **at an angle greater than 90° to the wake direction**. Refer Attachment 1.

This is a clear example of how force directions can be deduced by observing wake directions. The finding is important when cricket balls, modeled by Reynolds number similarity are subjected to smoke injection and create wakes that are easy to observe in wind tunnel tests [Alam, La Brooy & Subic (2008)].

An elementary analysis of momentum will confirm the foregoing. In reality, a wake signifies the presence of a transverse force component caused by a pressure difference on the halves of a ball.

## 3. Conventional Swing Scenarios

With reference to Figure 1, conventional swing bowling is executed when the ball is orientated so that shiny side of the ball becomes the non-seamed side of the ball. The ball will follow the direction of the seam and its flight is easily seen and predicted by a batsman. This type of swing occurs during the first 15 overs using a new cricket ball. Often the least damaged ball half is identified quickly, polished and so maintained by the fielding team, allowing the other half to deteriorate.

### 3.1 Scenario 1 – New ball, conventional swing

Consider a new ball having *two* shiny surfaces, represented in Figure 5. Such a ball is very prone to swinging in the conventional manner. In this scenario, a laminar boundary layer forms on the shiny non-seam side and being relatively unstable, will separate early[1]. A similar laminar boundary layer forms on the opposite (seam side) which is also shiny. However this laminar boundary layer can be *tripped into a turbulent boundary layer when the air encounters the seam's roughness.* As a result, this boundary layer will separate later[2] (ref Figure 2) as it is more stable than the laminar boundary layer and clings to the surface over a longer distance.

Now the asymmetric separation points of the boundary layers on each side of the ball create a net pressure difference, resulting in a force. The effect of this force is observable by a wake pointing rearwards, now aligned with the angled seam.

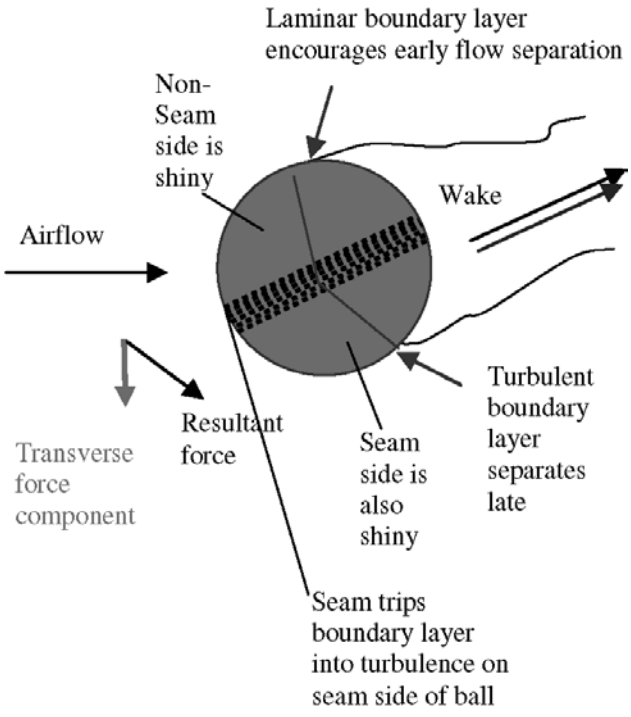



*Figure 5. A new ball depicting the mechanism of conventional swing*

The wake direction in Figure 4 indicates the presence of a resultant force that can be resolved into parallel and transverse components with respect to the airflow. Only the important transverse component of the resultant is shown

1. *At approximately 90° to the direction of motion.*
2. *At an angle >90° to the direction of motion.*

in Figure 5. This is the force component that causes the balls direction to drift sideways from its straight line trajectory to follow the seam's direction. The batsman can then play an appropriate stroke by observing and following the seam's orientation. **The key requirement for conventional swing is to have a shiny surface on the ball, aided by a prominent seam.** Both 2 and 4-piece balls can swing in this manner and the art is not difficult to master.

### 3.2 Scenario 2 – A deteriorating ball

Now consider a ball that has deteriorated in play, has had only one side kept polished and then possesses both shiny and rough halves. The situation is similar to Figure 5 where the **shiny half of the ball** is physically placed on the non-seam side. Here, a laminar boundary layer will be established as before and will separate early. Figure 6 shows a plan view of the ball where a small length AB of the shiny, *non-seam* side of the ball points directly at the batsman. The flow around segment BAD will be laminar. The flow around AB is laminar until the seam is encountered. This laminar portion of the boundary layer on the seam side will be tripped into a turbulent boundary layer by the seam and remain turbulent, encouraged by other roughness elements on the seamed half of the ball. This will cause flow separation late, at C.

Asymmetric flow separation on both sides of ball creates a wake that again points rearwards, and is aligned with the seam. As before, the implied resultant force is shown where the transverse force component points towards the rough seam side, causing the ball to swing in this direction. The ball then follows the seam alignment and swings from the shiny to the rough side.

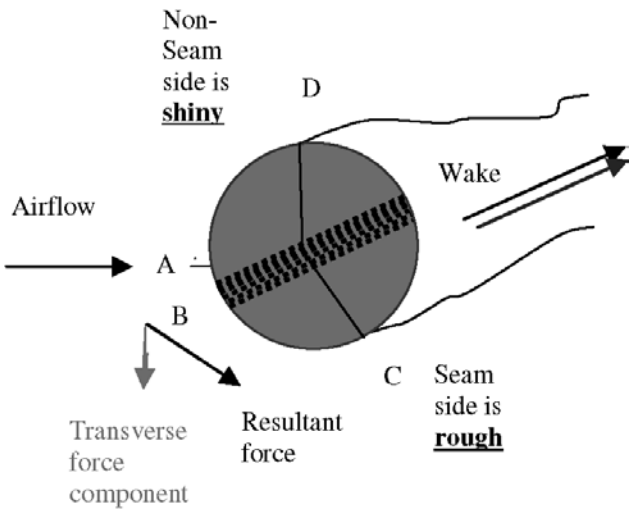



*Figure 6. A Deteriorating Ball*

### 3.3 Scenario 3 – Old ball, seam pointing directly down the pitch

Reconsider an old ball with rough and shiny halves bowled **with the seam pointing directly at the batsman** as shown in Figure 7. The shiny side is located as shown. This ball will swing at moderate bowling speeds by applying the foregoing theory. Here the boundary layer will be laminar over the shiny half AD separating early at D. The boundary layer AC will be turbulent because of the roughness of surface AC and flow will separate late, at C.

Asymmetric flow separation on both sides of ball creates a wake that again points rearwards. In this case the wake exists in the same direction as before, implying the presence of a resultant force whose transverse component is directed towards the rough side. The ball now swings from shiny to rough sides but does not follow seam direction. This scenario can be achieved when bowling at moderate speeds.

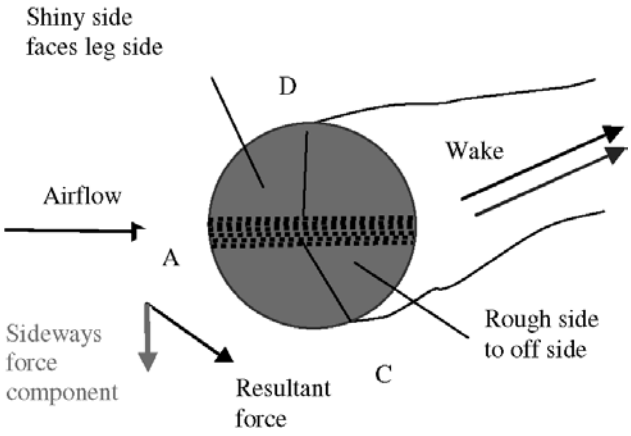



*Figure 7. An old ball, seam pointed down the pitch*

*In every instance of the foregoing scenarios underlying conventional swing, the ball moved from the shiny to the rough side. When the seam was angled, the ball followed the seam direction in its trajectory to the batsman. In scenario 3, the ball was held pointing directly down the pitch. In this instance too, the ball swung from the shiny to the rough side. It is known that batsmen can recognize the shiny side of the ball during at worst, the second half of the ball's trajectory in its flight towards them. Clearly the batsman on strike needs to be vigilant to identify the shiny side of the ball. Assistance may be gained from visual cues or from actions of the non-striker.*

The foregoing has been applied to the general case of 'outswing' to a right hand batsman as depicted in Figure 1. A mirroring of the ball about the centre line of the pitch produces 'inswing' with the similar arguments applying equally to this type of bowling.

## 4. Reverse Swing Scenarios

Situations exist where the ball does *not* follow the observations outlined in section 3. In such cases the ball drifts in a direction *opposed* to the seam's direction. This section presents and explains two scenarios where this expected pattern (or 'swing reversal') can occur. The first of these occurs with a 4-piece ball only when bowled at very high speeds.

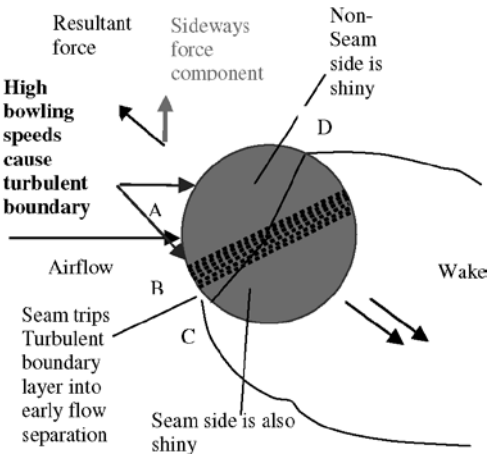



*Figure 8. A new ball, having two shiny sides, bowled very fast*

### *4.1 Scenario 4 – New ball bowled very fast*

Consider a new ball with two shiny halves. The situation is similar to Figure 5 however when bowled at *very high speeds*, turbulent boundary layers will form initially on both halves of the ball. This is depicted in Figure 8.

The boundary layer being turbulent on the non-seam side will cause late flow separation, at D. When the **already turbulent boundary layer** on the seam side, **over AB**, encounters the seam, Mehta [1,2] suggests that the turbulent boundary layer is *thickened* more, becomes unstable and flow will separate *very* early at C. This now creates a wake that is generally angled *across* the rear of the seam, signifying the existence of a transverse force component at >90° to the wake and directed towards the non-seam side of the ball. **This results in the ball that can swing in a direction *contrary* to the seam's orientation.**

This 'reverse swing' will occur without notice, is completely contrary to the ball following seam direction and is then dangerous for a batsman.

This scenario teaches that for reverse swing to occur, it is important that a *turbulent* boundary layer be established over the non-seam half of the ball – *in whatever manner this may occur*. Additionally, it is important that this turbulent boundary layer is present over the critical region AB. Now the presence of the seam can cause the already turbulent boundary layer to facilitate flow separation early at C. A host of new scenarios can then follow.

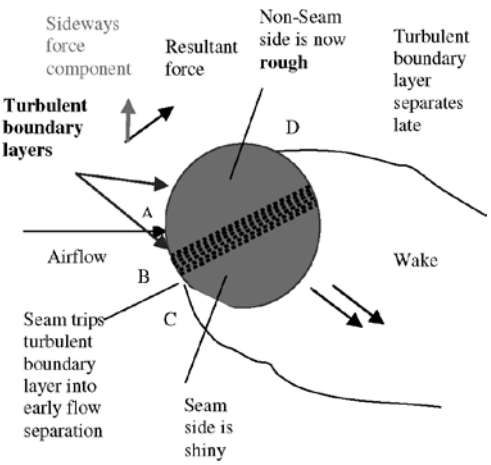



*Figure 9. How a deteriorating ball can reverse swing at moderate speeds*

### *4.2 Scenario 5 – A deteriorating ball with rough and smooth sides interchanged*

Now consider a deteriorating ball bowled at moderate bowling speeds and polished on only one side. This will normally promote conventional swing if the ball is orientated as in Figure 6. However section 4.1 showed that the ball can reverse swing if a turbulent boundary layer can be established over the entire non-seam half of the ball. Mehta [1-3] suggests that this can be achieved simply by interchanging the positions of rough and smooth halves of the ball to produce the situation depicted in Figure 9.

If this is so, a turbulent boundary layer is propagated on the non-seam side by virtue of the ball's roughness and will cause late flow separation, at D. A turbulent boundary layer commences to form over the small region AB because the ball is rough over that half. Hence even at lower speeds, when the already turbulent boundary layer on the seam side encounters the seam itself, it *thickens* more and as before, becomes unstable and will cause flow separation early at C. This creates a wake that is angled across the rear of the seam indicating the presence of a transverse force component directed towards the rough side of the ball as shown. The wake and force diagrams are then similar to the previous Figure 8. So even though the seam of the ball points as shown, the ball can swing in the opposite direction, *i.e. from the shiny towards the rough* side even at low bowling speeds. Again watching seam direction alone can deceive a batsman. *It is crucial to detect the shiny half of the ball* because in either conventional or reverse swing, the ball will move from shiny to rough sides.

## *5. Backspin*

In all of the bowling scenarios cited, backspin is always imparted to the ball through the normal bowling action. If back-spun deliberately, by use of the third finger (the last to leave the ball), rates of approximately 10 revolutions/second or more can be generated. This creates gyroscopic stability and the ball's orientation can be maintained throughout its trajectory-until it bounces on the pitch[3].

## *6. The Critical Effect of the Quarter Seams*

First-class cricket balls comprise an outer skin of four quarters. Two halves are constructed with two quarters sewn together internally. The halves are joined together with an external seam comprising 6 rows of 80 stitches for a Kookaburra ball. This situation is depicted in Figure 10.

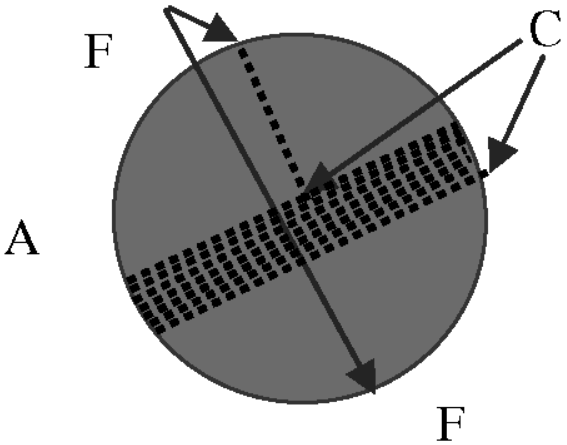
Junior cricket balls only comprise two halves. It has been observed that almost super-human bowling speeds are needed to generate reverse swing with 2-piece balls

3 *Glen McGrath is probably the best exponent of this art*

even though the conditions of Figure 9 can be met. In order to explain how only a 4-piece ball can reverse swing, the potential influence of the quarter seam must be considered.

If a quarter seam becomes raised – *particularly in the critical region AB*, the author postulates that a turbulent boundary layer can be propagated in the vicinity of the seam. This boundary layer can then thicken and separate when it encounters the seam as in Figure 9. The thickening of the boundary layer causing early separation has been postulated by Mehta [3].

In the past, teams have been reported to have tampered with the ball, employing illegal practices. The author suggests that maximum benefit would accrue if the quarter seam was lifted in the region AB (i.e where the quarter seam meets the main seam) or if the ball was scratched deliberately over regions on one half of the ball. An equivalent effect can be achieved legitimately if fielders throw the ball with the seam orientated parallel to the ground with the roughened half downwards, thrown to reach the wicket keeper on the first bounce. A more pronounced effect may be achieved by employing certain legitimate, bowling strategies in the early overs of a cricket match.




Lifting or roughened one quarter seams **near the main seam** at either position C increases turbulence on one side of the ball in the zone AC. Roughening apexes F has minimal effect

*Figure 10. Seams of the ball*

## 7. Special Case

### 7.1 Scenario 6

Section 4.1 taught that reverse swing can occur if a turbulent boundary layer is established on the non-seam half of the ball including the critical region AB. Consider the hypothetical case of a deteriorating ball now bowled very fast, with the shiny side placed on the non-seam side (inside) and the rough half placed on the seam side (outside) as was depicted in Figure 8.

The boundary layers on both sides of the ball will be turbulent because of the speed of delivery. The layer on the shiny side will aid flow separation late at D and that on the rough side will cause separation early at C. This is due

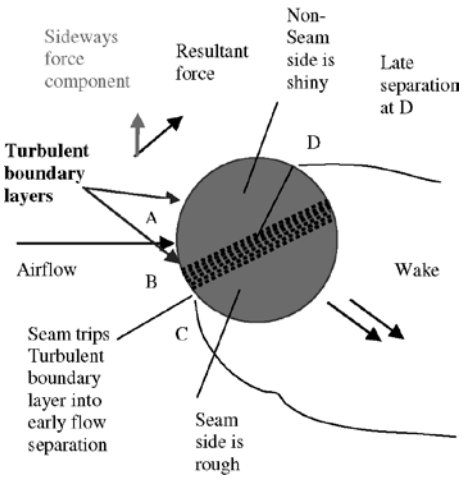



*Figure 11. A deteriorating ball bowled very fast so that a turbulent boundary layer is created on the non seam side*

to the initial turbulence of the boundary layer particularly over region AB[4].

The wake direction will be downwards, indicating the presence of a transverse force on the ball now pointing from ***rough to shiny*** sides.

This scenario is dangerous because not only does the ball defy its projected seam orientation-but also travels from rough to shiny sides-a situation not encountered before.

How can this paradox be addressed and how can a turbulent boundary layer be created on the *shiny* side of the ball?

Table 1 summarises the presentation to date.

## 8. Early Reverse Swing

When Pakistan practised the art of reverse swing, the ball was made to so do when it was quite old (50+ overs)[5]. The English in the 2005 Ashes series were able to do so after only 10-15 overs and the ball maintained its capacity to reverse swing for a further 10 overs. An explanation of how this may have been achieved legitimately, follows.

Outswing is achieved by yawing the wrist anti clockwise principally, cocking the wrist and backspinning the ball with the third and fouth fingers on launch. These actions are depicted in Figure 12.

Opening bowlers can also become practised in the art of bowling as for conventional swing with an **added roll** of the wrist (refer Figure 12). When bowled in this manner, there is a high statistical probability that the ball will land near the outer edge of the seam. Repeated bowling over 10 overs with this slightly rolled wrist will scuff the ball in a latitudinal band parallel to the seam. An artificially scarred new ball possessing this type of degredation is depicted in Figure 13.

4 *The effect of roughening or broadening the seam over AB has not been commented on*

5 *Sarfraz Nawaz was credited with discovering how to execute revese swing, passed it Imran Khan, Wasim Akram and to Waqaur Younis who purportedly passed it on to Simon Jones and Andrew Flintoff.*

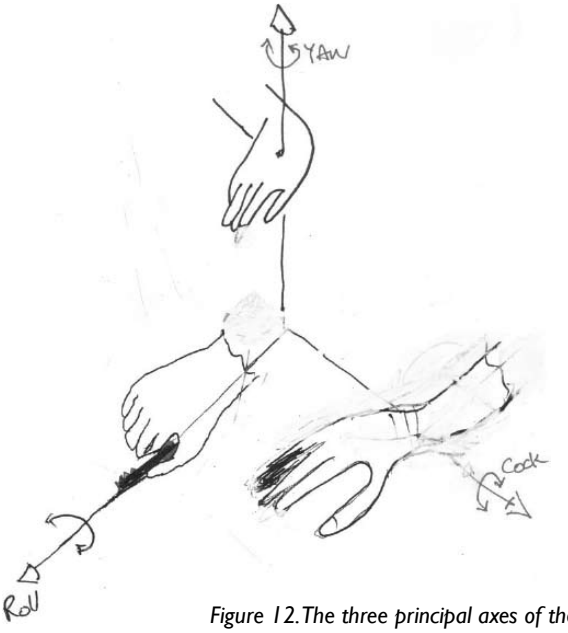


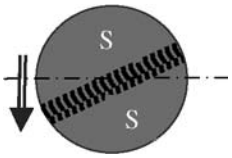
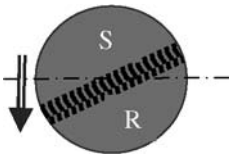
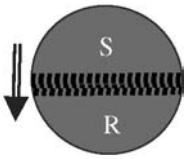
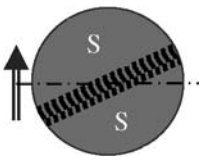
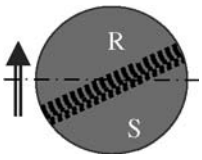
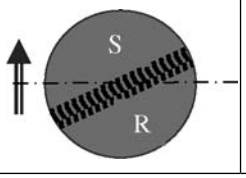

*Figure 12. The three principal axes of the wrist*

*Figure 13. Artificial disfigurement of the ball to simulate bowling with a rolled wrist over the initial overs*

Sufficient disfigurement can be attained after 10 overs if both opening bowlers focus on pitching the ball off the seam to land the ball in the *same* half in the same zone. Reverse swing can then be attained by the second change bowlers to exploit the phenomenon at a much earlier stage of ball degredation than was ever thought possible before.

Figures 14 and 15 show how the ball of Figure 13 can be reorientated at will. The scuff zone can then be positioned

**Table 1. The effect of using a cricket ball in differing fast bowling situations**

| Scenario | Bowling speed | Swing type | Ball cnd$^{n}$ | Plan View & Tranverse Force Dirn. | Ball swing direction | Indicator |
|---|---|---|---|---|---|---|
| 1 | Normal | Conventional | New |  | S to S | Trajectory follows seam dirn |
| 2 | Normal | Conventional | Deteriorating |  | S to R | Trajectory follows seam dirn; moves S to R. |
| 3 | Moderate | Conventional | Old |  | S to R | Ball moves from S to R |
| 4 | Very Fast | Reverse | New ball, 4 piece |  | S to S | Trajectory does not follow seam dirn. Batsman deceived by seam dirn |
| 5 | Moderate | Reverse | Deteriorating 4-piece |  | S to R | Batsman deceived by seam: ball moves contrary to seam dirn. |
| 6 | Fast | Conventional | Deteriorating |  | R-S | Batsman deceived by seam at moderate speeds: Ball moves from R to S |

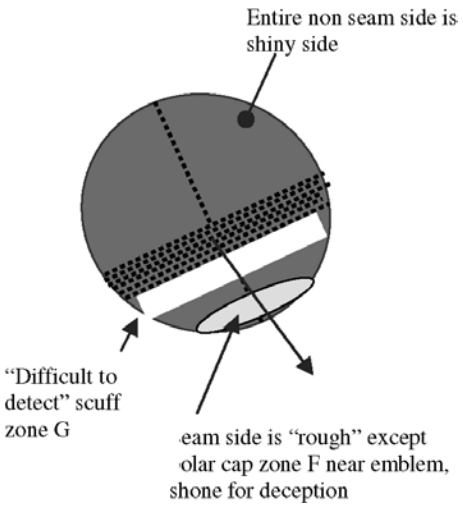



*Figure 14. Plan view of ball showing scuffed landing zone facilitating early reverse swing*

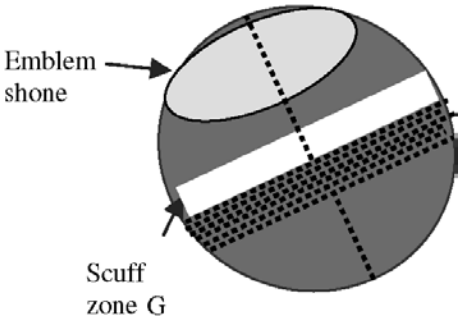



*Figure 15. Reorientating the ball to initiate a turbulent boundary layer on the non-seam side*

to facilitate premature boundary layer separation and reproduce the scenarios presented in this paper.

When a ball has been so conditioned, the region between the scuff zone and ball apex can even be shone (near the emblem) for deception, making it nearly impossible to distinguish visually between rough and shiny halves (see Figures 14, 15).

A new ball so scuffed can form the trigger for a multitude of scenarios described in the paper. For example, consider the situation depicted in Figure 16. The scuff zone can *initiate* a turbulent boundary layers on *both* sides of the ball-even at low bowling speeds. Consider its effects on the upper half of the diagram: Being a turbulent boundary layer, flow separation is expected to be late at D. The same scuff zone can also initiate a formation of a turbulent boundary layer on the other half of the ball (see lower half of diagram) to facilitate an already turbulent boundary layer's early separation at C. Both these separations will cause a narrow and *focussed* wake, suggesting that the transverse force component will be large, causing significant reverse swing-even at low bowling speeds.

It has been suggested that an excessive use of saliva on the absorbent, rough section of the ball may assist tilting the ball in flight, by biasing its weight distribution in a similar manner to a lawn bowl. Whilst plausible, this has not yet been substantiated.

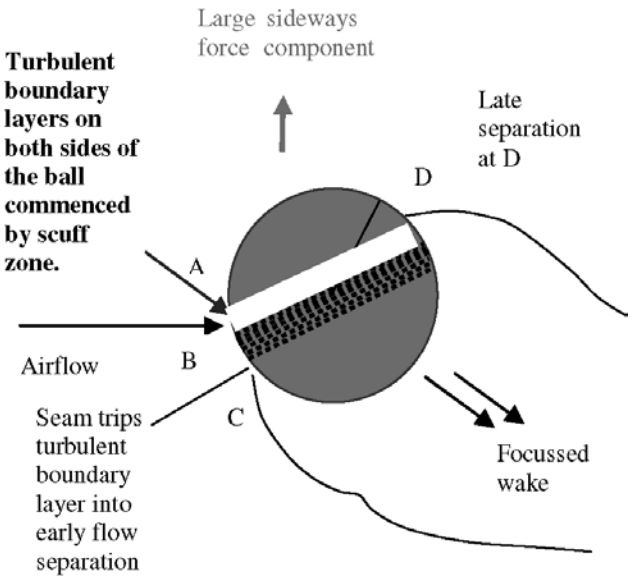



*Figure 16. One scenario where the scuff zone may be used effectively for reverse swing*

## 9. Strategies to Counter Reverse Swing

A strategy to combat a ball ***that was reverse swinging*** once appeared to rely heavily on the batsman's capacity to pick the shiny side of the ball. Clearly, the situation can become much more complex. In order to minimise the effects of reverse swing, it should be recognised that for a ball to swing, it needs to spend as much time in the air as possible to maximise the effect of the transverse force. It should therefore be of full length. The prospective length of a delivery can be recognised easily by most batsmen by using visual cues to determine if the bowler releases the ball before or after the vertical. Acquiring this skill is elementary and instinctive for a batsman, as it dictates whether the ball ought to be played on the front or back foot. Balls that swing often are subject to the most displacement late in their trajectory and so should be played on the front foot. It makes sense that during a period of reverse swing that the batsmen curtail their backlifts, get to the pitch of the ball and nudge the ball until the conditions of reverse swing are defunct[6]. Allied to this would be to watch the ball carefully, delay strokeplay and not follow through extravagantly. This technique is often employed on rain-affected pitches by competent club-level cricketers. The period of reverse swing in Test cricket appears to last 10-15 overs.

## 10. Conclusion

The author has presented known experimental and observed results and placed them in a cohesive framework leading to investigating new methods to reverse swing a cricket ball. A range of scenarios was presented, in

6 *Will occur when the circumstances of Figure 11 can no longer be maintained*

agreement with what has been observed at first class level. The paper relates part of established theory with practice. Key scenarios were summarized in Table 1.

## 11. Acknowledgements

The author acknowledges the work of Dr. R. Mehta and the many conversations had with former Test cricketers Messrs. Saliya Ahangama and Ravi Ratnayeke of Sri Lanka and Matthew Elliott and Dean Jones of Australia. I acknowledge the informal talks with Drs. Jon Watmuff and Firoz Alam, of the School of Aerospace, Mechanical & Manufacturing Engineering.

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## Attachment 1

Consider a control volume containing a cricket ball where inflow and outflow mean velocities are Vi and Vo respectively. Now Force=Rate of change of momentum whence

$F = d(mv)/dt = dp/dt$

Expanding,

$F = mdv/dt + vdm/dt$

For constant mass flow rates, $dm/dt = 0$ and:

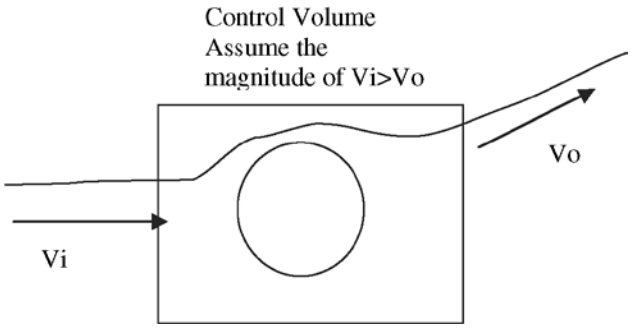
$F = mdv/dt = dp/dt$

For discrete changes;

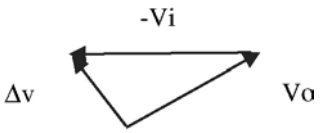
$F = m\Delta v/\Delta t = \Delta p/\Delta t$ whence;

$\Delta v = \Delta p/m$

Consider the control volume around an object that experiences a change in velocity of Vi to Vo (when an angled wake is produced).

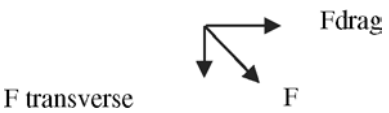



Then $\Delta v$ is as shown and:




From earlier equations, vectors constituting $\Delta p/m$ are equal to $\Delta v$ and the magnitude and direction of the force F to counter $\Delta p$ is


The resultant force F can now be resolved into drag and transverse components as shown, in agreement with the earlier description in Section 2.



# A Model for Health Care System Reforms

*Dr. John Blakemore*
*E: masc@blakemore.com.au*

The Australian health care system is in need of substantial structural and financial reform. Demands on it are increasing exponentially because of higher patient expectations, obesity, ageing, a greater emphasis on technological solutions and the associated increase in lifespan. All this places increasing financial burdens on hospital care, primary care, and aged care. Whilst clever innovative surgery such as the Da Vinci method for prostatectomy and the use of increasingly sophisticated diagnostic devices like the new generation MRI scanners, provides the opportunity for superior diagnostic solutions, the use of such equipment is expensive and is only quickly accessible for private patients or patients of considerable wealth.

The system must become more efficient and there has to be a significant increase in productivity with an associated decrease in cost and improvement in the quality of services, processes, systems and procedures.

In many ways there are opportunities in other industries where new measurement and organisational structures and improved control of processes if applied to the healthcare industry can assist in strategically improving the health of all.

A model that can be used to accelerate improvement and innovation, is that implemented in the automotive industry. Honda is perhaps the best example of what can be achieved if the correct structure, processes and systems are put in place to release latent process and product innovation and remain as a leader.

The Honda manufacturing system incorporates the original ideas of the best process and systems scientists and engineers, like Walter Shewhart, W Edwards Deming, J M Juran, Soichiro Honda and Taichi Ohno.

This method and model has been extended and successfully implemented in Australian businesses from $20 million to $1 billion turnover per year through ERP and IT system development. The same opportunity exists for the use of digital data and E health in the healthcare industry using what is called six sigma processes and systems. The healthcare industry needs to embrace the digital evolution.

The Shewhart/Deming philosophy of teamwork, process control, measurements and kaizen, all combined in a strategic business plan with the correct policies and procedures in core business areas offers new hope for improved productivity and customer care if implemented in the healthcare industry.

A prerequisite for a successful healthy life is a system of healthcare based upon continuous monitoring and prevention based processes.

As stated in "Quality Habits of Best Business Practice", I believe that quality must become a habit. This is the main reason for the outstanding success of Japanese manufacturing and later Japanese service industries. Despite massive re-evaluation of the Yen, these industries are still largely trading in surplus.

Quality must become a habit and a quality habit can be defined as:

> *"…a settled way of behaving automatically and consistently at a level of general excellence which has a specialised characteristic that inspires confidence."*

On my many tours around the studying the best business systems available, I discovered the Sayama plant of Honda, which was recognised as the best factory in the world by J.D. Power and Associates USA. An overriding principle of their business management system in this case is that they do not make to a tolerance – **they make to a target.** That is, they go beyond the **Six Sigma Process** control system of Motorola in the USA.

The overriding philosophy there is:

1. Quality is a habit
2. Defects and errors in systems and processes are not acceptable
3. Six Sigma Processes are a must.
4. Perform to a target, not to a tolerance
5. Improve on the perfect
6. Kaizen every way, every day
7. Maximise the innovative talent of all stakeholders.

Toyota also practised the same philosophy but in 2009 they made a strategic decision to remove a lot of senior managers and replace them with younger ones. Unfortunately, these new managers were not trained in the Shewhart – Deming philosophy and the results have been catastrophic.

My own belief is that if there is ever an industry that needs to go beyond the **six sigma process control,** it is not necessarily the automobile industry, but definitely the healthcare industry. The old ideas of capability index of being plus or minus the three sigma process must be improved upon for surgery and treatment.

Very often hospital corporate plan documents are weak on data and statistics and good quality information and analysis. However, the basic philosophy of the existing corporate plans makes it relatively easy to translate strategic directions into key performance indicators and link them with the information and analysis in terms of quality criteria, therefore satisfying **six sigma process** in the healthcare industry.

The mismatch between common corporate plan themes and quality criteria in the area of information analysis can form the major framework for an improved model when combined with a more efficient structure focussing on prioritising all work activities.

It has been my experience that once the organisational framework has been sorted out, this area needs strengthening in all service related industries, pathology departments, sales and marketing, medical healthcare, rehabilitation, medical centres, restaurants, retail and wholesale trade, and many more. The major driving force behind improvement and, in fact, behind Kaizen, is that if we are to achieve world-class quality or world-class healthcare, will be ***measurement*** based on prevention.

As far as people are concerned, teamwork is absolutely fundamental if world-class healthcare is going to be achieved. In fact, world-class healthcare endorses the wisdom of a multi-disciplinary diagnostic and treatment approach and, from this, the logical use of statistics, data measurement or information and its interpretation – the international language of quality. Every input of symptoms to a disease requires a broad set of skills for interpretation. A good health system is a shared responsibility of all parties.

In addition, Dr. Deming has estimated that more than 94% of outcome problems reside in the process itself. If the process is to be improved, it has to be measured; hence, teamwork, cooperation, collaboration and process control are absolutely essential to the quality approach.

A world-class healthcare system needs to acknowledge the professional peer relationship that exists between medicine, behavioural science and education. It applies all the relevant knowledge of a well-informed population.

As has already been recognised, there are strong parallels between the manufacturing industry, the development of process control and delivering a world-class healthcare system.

To complete the loop and provide continuous improvement, the patient outcomes should be measured. Such a system already exists overseas as PROM (Patient Reported Outcome Measurements).

Good health outcomes should be regarded as the equivalent of profit in a business, there has to be a system to apply this business philosophy.

A proposed structure using digitally linked hospital networks sharing data and resources and specialist knowledge, in turn linked to care based local medical centres can easily be based upon a quality focussed system. Continuous monitoring must take place through a top level measurement authority focussed on performance outcomes and accountability.

The healthcare system can learn a lot from what has already happened in the quality management systems applied by some of the best companies in the world, those of which are already aiming for and surpassing six sigma process quality levels.

# IIE Accommodates Special Interest Groups (SIGs)

*Daniel Kulawiec*

As the 2009/10 year draws to a close, challenges faced by our Australian Society continue unabated. The dual pressures of increased environmental awareness (demanding more efficient and careful use of resources) and the recent financial crises (demanding a more productive and lean business environment) has seen our Industrial Engineering skills more in demand than ever. By adapting and utilising their skills, Industrial Engineers are well positioned to take key roles in the companies and communities in which they work.

As expressed in previous editions of **New Engineer**, the one area that remains less developed is the level of professional activity between members. In addition to representing and promoting Industrial Engineering to the wider community, the Institute exists to serve its members and provide the platform for members to discuss issues, undertake ongoing professional development and to share knowledge.

In a strategy to improve member engagement and services, the IIE is commencing the establishment of SIGs to

better serve the needs of its members. The SIG mechanism will allow any group of Engineers within the Institute with a common interest, or special need, the platform to work with like-minded Engineers.

Initial groups are being established by our Monash Alumni members, and also by our members specialising in Manufacturing. Through the IIE, they will provide the environment and resources to develop and pursue items of common interest to their members.

***What is the value to members in taking part in a SIG?***

The SIG can offer the member community:

- Professional recognition of specialist qualifications
- A forum and environment for members to continue to meet and focus on matters of interest
- **New Engineer** as a regularly published journal that can be used to share information across group members
- Support (financial and otherwise) for activities and events
- Access to a website that can be expanded to add specific SIG page/s
- Opportunities for further professional development and training
- The structure and framework to manage membership (including member database and fee collection if required)
- Access to other members and like-minded organisations
- Access to Engineers Australia vast resource

***What is the value to the IIE in accommodating SIGs?***

The creation of the SIG structure has several advantages for the IIE:

- Service the specific needs of current engineering members
- Introduction of new ideas and thoughts across the Institute
- Potential for new events to be staged that could interest the wider IIE membership
- Options for new quality material to be disseminated through the **New Engineer** journal to prompt discussion across the broader IIE and Australian communities
- Introduction of new skills that the Institute and industry can access
- Opportunities to attract further members through the personal and corporate networks of the SIGs

I see this as a positive move for our Institute. If you are interested in forming a Special-Interest-Group, or becoming a member of either the Monash Alumni or Manufacturing SIG, please contact me for further information.

Another opportunity to increase the level of IE activity is through well planned conferences or seminars that address issues of keen interest to Engineers and Industry in general, and to Industrial Engineers specifically. Many members may not be aware that both IIE and Engineers Australia are very supportive of these types of initiatives. Both organisations can provide both direct and in-kind assistance for events that align to the purpose and objectives of the organisation. This can include financial support and seeding capital where appropriate. I would encourage any member that is keen to further explore opportunities in this area to contact me.

# Networking Tools for IIE members

To assist with networking and collaboration between IIE members, a discussion 'group' has been set up on the social networking site Facebook. This 'group' will be for the discussion of new and developing theories and methodologies being used within industry as well as allowing for members to interact more readily with each other.

In addition to the Facebook group a LinkedIn group is also in the process of being created.

As well as offering the fantastic opurtunity for networking with other IIE members, both of these networking sites offer a fantastic method for the IIE to keep you, its members, informed of upcoming events.

To join the Facebook group simply search for "Institute of Industrial Engineers Australia" and click on "join group".

Please send your questions regarding the social networking groups to: scottfairburn1@gmail.com. I look forward to hearing from you on the networking sites shortly.

***Scott Fairburn, Director GradIIE***

# Lean and the Balanced Scoreboard

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## *Introduction*

The principles of Lean manufacture developed from Total Quality management (TQM), Just in Time (JIT) and Statistical Process Control (SPC) and customer focussed initiatives, based on the balanced scoreboard, can be applied to all functions of all businesses. These principles can be used to produce a ***Lean and Balanced Scoreboard,*** which can enable the business to focus and prioritise its activities to the maximum benefit of the customers, employees, suppliers and shareholders. This is a way of linking strategy with capability and minimising waste and maximising the use of capital and labour. These measurements should be regarded as top priority in determining the capability and performance and future strategies to determine the directions for continuous improvement and improved competitiveness.

## *General*

The future doesn't just happen, ***we create it***. Globalisation and the digital revolution has accelerated the pace of change and the need to be more innovative more quickly. IT systems have created a tool to supply accurate digital data instantaneously from the point of sale. A balanced system of measurement is therefore necessary to enable the organisation to take the initiative as more and more players emerge on what remain as uneven playing fields. To respond to all these changes, we must be quicker, more imaginative, more creative, honest and more scientific in our approach to all business decisions.

Hence measurement systems must be fast, accurate and provide data that can be used to continuously and quickly monitor the underlying strategy and match it with the system capability to enable organisations to alter course quickly if necessary and so minimise risk of failure and maximise the chances of success.

The most effective way of doing this is to use the ***Lean Balanced Scoreboard.***

## *The Future*

Future business change will occur even more rapidly than now. It is essential that all businesses are prepared for such continuous change occurring at an accelerated rate. Already quantum computers are on the drawing board and global accounting and financial rules are being prepared to control global business more effectively, equitably and honestly. All this points to ever increasing competition and a greater emphasis on digital data and its use and advantages… Bill Gates has called it business@thespeedofthought. This is **e-business**. The vertical organisation structure will be replaced totally by a vertical/horizontal matrix.

Based upon these there are a number of management concepts that we can use to hone our competitive advantage, concepts that will help us prepare for a seamless structure based on teamwork, innovation and flexibility.

The winners in the future will be those that can harvest the advantages of the new digital technology and learn quickly and so take advantage of the new opportunities we create. This is the world of the knowledge workers.

## *Establishing, Measuring and Managing the Lean Balanced Scorecard*

In the past the financial measurements (profit and loss, balance sheet and cash flow) were the main board level measurement and management tools. Clearly they are not enough.

The themes needed are financial, operational, and reflective of the strategies and capabilities of the organisation in HR, innovation, marketing sales, operations, and the total supply chain. The usual financial themes are:

- Revenue Growth
- Productivity Improvement
- Capital Utilisation

These need to be supplemented by a broader set of measurements. The key is the buying decision which if understood can lead to increased customer satisfaction, profitability, and growth.

Business is about quality, cost and delivery, no matter what the service or product. Lean systems digital thinking must be practised in all parts of the business.

All major strategic elements of the business must be measured and integrated into the business plan. These should in turn be balanced by the capability of the organisation and the goals set for its improvement.

## *Processes and Systems*

Processes that service the customer most effectively are characterised by maximising the value added. Such processes when linked together in a chain form systems with a high degree of effectiveness and in turn create Just-In-Time relationships. This means that the capability of the process and system must be understood and measured.

Dr Deming supported this statistical approach when he revolutionised production and manufacturing processes in Japan after the second world war. This gave rise to the quality revolution and Total Quality Control (TQC) and later Total

Quality Management. The ISO quality system tried to emulate this but did not understand the importance of prevention but it is slowly catching up. In the meantime Toyota has dropped the ball because they failed to pass on the learning of Dr Deming from the old generation to the new.

The continuous drive to improve and innovate has led to what is called six sigma processes.

## The Supply Chain

Any organisation is only one step in a total chain and the chain is only as good as it's weakest link. This means in turn that we all are a customer and we all have a customer no matter who or where we are in the chain.

Lean thinking rules apply to all steps in the chain and to the links between the partners in the chain. With a lean system, organisations can respond to the ever changing demands of the marketplace with minimum disruption and cost. This leads to an innovative adaptable team based culture.

The digital revolution creates a wealth of new opportunities to get closer to the customer and develop special relationships which can be managed more efficiently.

For the private sector this means there is a sharper focus on the strategic use of information and the increased return on capital employed (ROCE). For the public sector it means a faster turnaround of jobs, less queuing time and reduced costs.

## Innovation

Successful organisations in the future will focus more and more on innovating process, product, service and the organisation structure itself.

The special relationships between product and process innovation need to be explored and related to core functions in the organisation.

## Development of the Lean Balanced Scoreboard

### Outline

Firstly the ***VISION AND STRATEGY*** must be defined. These should be linked to the major issues controlling the Lean Strategy:

- Aims and Objectives
- Measurements
- Targets and Timelines

*The issues are:*

1. ***Marketing and Sales (Customer Focus).***
2. ***Operations (Systems and Processes, Internal and External)*** The development of the systems processes and organisation's capability to deliver the defined strategic outcomes must be linked to the customer.
3. ***People (Learning and Education, Training, Performance)*** In order that the vision may be achieved, the ability to change and develop will depend on our ability to enhance our skills and knowledge.
4. ***Innovation,(Product, Processes and Systems),***
5. ***Financial Outcomes (P&L, Balance Sheet, Cash Flow)*** The final analysis for private companies is the creation of shareholders wealth. For government organisations it is satisfying all the stakeholders but focussing on cost reduction and speed.

## Measurements (some suggestions)

### Lean Scoreboard

| No | Function | KPM | Y/N |
|---|---|---|---|
| 1 | Marketing and sales | Quality cost, on time % | |
| | | Market share by product and segment | |
| | | Hit rate | |
| | | No of customers (new, lost) | |
| | | Opportunities created | |
| 2. | Operations (e.g. manufacturing) | Run % by machine %crewed | |
| | | Cycle time | |
| | | Downtime | |
| | | Preventive maintenance | |
| | | Total waste by machine | |
| 3 | People | Basic training % | |
| | | Advanced training % | |
| | | Absentee rate % | |
| | | Average age employee | |
| | | % With direct replacement | |
| 4 | Innovation | No new products per year | |
| | | Success rate new products | |
| | | No new processes introduced | |
| | | R&D programs completed | |
| | | R&D programs started | |
| 5 | Financial | P&L, BS, CF | |
| | | Key financial ratios | |
| | | Inventory days | |
| | | Days to produce accounts | |
| | | Total GM, OP, EBIT % sales | |

The above concept provides a framework for continuous innovation and improvement. If applied and continuously developed and understood it takes industrial engineering and strategic planning to a new level.

# Small Business Mentoring

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## *Introduction*

First, before launching into 'small business mentoring', we must define what is a small business?

World-wide, the definition of a small business varies: in Australia, the Federal Corporations Act 2001 defines a small business as one that has less than 50 full-time employees; in the USA this is a business having less than 500 employees; in Japan they call them SMES (Small & Medium-sized EnterpriseS) these companies have less than 300 employees and in Europe, SMES have less than 250 employees.

Australian small business makes up nearly half the economy and employs one in every two Australians. See Figure 1.

| **Australian Small Business[1]** | |
|---|---|
| 1. | More than 95% of Australian businesses have fewer than 20 staff |
| 2. | Small businesses provide employment for about 5.1m people |
| 3. | They export goods to the value of about $1.2b |
| 4. | They account for about 39% of private industry value-added each year |
| 5. | Over 300,000 new small businesses are started annually |

*Figure 1. Attributes of Australian SMEs*

## *Why do people start a small business?*

In Australia, one reason is that the commercial culture believes that people over the age of 45 years are too old to become managers, etc. so therefore many of them have little choice (when laid off) but to start their own business. These people are sometimes called 'Necessity Entrepreneurs'.

Another interesting phenomenon (with respect to SMES in Australia) is that many new businesses are started by females as they are reported now to be better university-educated than males.

Social/technology developments also encourage the creation of new businesses: the Internet is creating many new service companies; increasing social unrest is creating many new security organisations; environmental interest is also creating many new consultancies and IT developments are creating new software houses. These aforementioned people are increasingly referred to as 'Opportunity Entrepreneurs'.

A survey[2] in 2008 found that two out of three owners wanted to be their own boss and that the freedom of owning their own business was the main driver behind their decisions to go into business.

## *Survival rates for Small Businesses*

Information on the survival rate for new firms varies from country to country. In Australia, the Productivity Commission[3] found that about 66% are still surviving after five years, see Figure 2. The commission also found that the longer a business survives, the greater its chances of continuing survival.

| **Australian Small Business Survival** |
|---|
| Around 66% are still operating after five years |
| 50% are still operating after 10 years |
| Around 7.5% of businesses exit each year |

*Figure 2. SME Survival Rates in Australia*

Survival also relies on employment. Businesses that do not employ have a significantly lower survival rate than employing businesses. The USA Department of Commerce[4] found that seven out of ten firms lasted at least two years, and about half survive five years.

## *Small Business Mentoring*

The failure rate indicates many business people need help and advice, however, the cost of using consultants is too much for the average small business. So where do they go for help?

Generally, they go to their accountants, lawyers and friends. In the last 20 years, business mentors also have come to some prominence. Generally, some are small government organisations like local councils who are concerned about the survival of small business, in order that they can pay the council rates. In Melbourne, the Glen Eira and Kingston Councils started a free mentoring scheme for small businesses in 2003. The author was involved from the first and the scheme is still operating in 2010 with about 50 companies being mentored per year. The scheme was copied from a Tasmanian scheme in Hobart.

The Victorian state government subsidised SBMS (Small Business Mentoring Service Inc.) has been running since 1986 and has about 75 mentors.

In Kevin Rudd's national summit, one of the ideas was for Australia to create a 'Golden Gurus' organisation to help small business. SBMS is now part of the 'Golden Gurus' association.

## What is the definition of a mentor?

The word 'mentor' has its origins in Greek mythology and is used to define: 'A trusted friend & teacher, a wise person'. Mentoring is a relationship which gives Mentors the opportunity to share their professional, personal skills and experience with business people and to help them to grow and develop their businesses in the process. Overall, the end game is to obtain a result for the mentee.

The benefits to a mentee are many and include: a more experienced business person who can give superior advice to a mentee plus provide an objective sounding board to the owner.

## SBMS Inc.

SBMS is an independent not-for-profit organisation that works in conjunction with Small Business Victoria through the Victorian Government. It aims to improve the employment potential, sales and profits of small businesses.

Since commencement in 1986, it has assisted over 15,000 small businesses. Its mentors have backgrounds in marketing, sales, exports, finance and banking, manufacturing, retailing, franchising, tourism and other fields like software and museums. The mentors are selected for their experience which must include having being a general manager, have demonstrable, good, people-handling skills and possess a passion for helping businesses succeed. The mentors help the owners to improve their business by listening, giving clarity and providing them with the knowledge they need. The mentors are all volunteers and give their time for free. The mentees are charged a modest cost which includes GST and covers administration costs and mentors' out-of-pocket costs. See Figure 3:

| SBMS Fees |
|---|
| One session with a mentor $100 |
| Two sessions with a mentor $190 |
| Three sessions with a mentor $255 |
| Four sessions with a mentor $320 |
| Additional sessions $80 |

*Figure 3. SBMS Fees*

The mentoring also covers start-up businesses which currently account for about 25% of all businesses mentored. Some of the start-up businesses include Internet services businesses like eRetailing, BioFuels and high-tech manufacturing businesses.

SBMS also offers a range of programs for businesses that want to improve and grow. The programs are flexible and are suitable for both established businesses and start-ups.

The most successful program involves a business owner working with a mentor over a program of four sessions. However, the mentee can chose to have as little as a single session, or select from a wide variety of programs including an 'Expert-in-Residence' program which is given in a variety of locations; e.g., the CBD and in many Victorian Council facilities. This is where a mentor is allocated to a location for about five sessions at 45 minutes a session with up to five different business people.

The issues vary from start-up problems to solving specific financial, operational and legal problems. The idea is for the mentor to generate more sessions. The potential mentee can go to the excellent SBMS website www.sbms.org.au where the mentee can answer a few short questions to be guided to the program that best meets their needs. The mentee can then select a suitable mentor from the list of about 80 mentors. The mentee can then pay on-line on the website. The mentee will be contacted by the mentor by email or phone within 48 hours of receiving the payment.

The mentor generally visits the business owner at his place of business or home. The first session could take up to 2.5 hours depending on the complexity of the business. The second session is usually about a month after the first session. The third and fourth sessions are usually spread further out.

SBMS operates flexibly to changing mentors/adding/reducing sessions or getting a refund. If the mentee's needs change or different areas become a priority, the mentee can change to a mentor with the specific skill set the mentee needs.

## A Mentor's Experience

The author is an engineer with a MBA and is an experienced manager and management consultant / both with the Glen Eira & Kingston mentoring scheme and with the SBMS. He has mentored about 80 small businesses which include manufacturing and service companies: about 25% being start-up businesses. He has also mentored three museums: Vietnam Veterans at Philip Island, Queenscliff Maritime and the Warburton Museum. Initially, the author thought that he would be involved mainly with manufacturing businesses but experience has shown that mentoring can involve all businesses. It is interesting to look at some of the mentoring problems encountered so far to date. See Figure 4.

The interesting observation about the management problems encountered is that they are the same as they were 30 years ago! This is partly because, whatever the management theorists like to think, management appears not to be a progressive science: the same dilemmas and difficult trade-offs crop up time and again[5].

To solve these problems requires mentors to have wide experience. The author has found that it takes time to achieve improvements in small businesses. One of the better

success stories was that the author commenced mentoring a two person (ladies) business which offered two services - web design and PC problem solving. After about 3 months it was obvious that this business was not going anywhere. The author enquired about other activities and found that they had a small sideline business selling pet supplies on the web. The author thought it would be worth exploring.

The business started focussing more on the pet-supplies. This brought results and the ladies kept their stock in their bedroom and they did not like customers coming to their house. The business kept growing until they could afford to rent a shopfront with a warehouse area in the back. This move brought unexpected benefits: they started to sell from the shop front and their business changed to 95% Internet/5% shopfront plus they got credibility with the vendors who prefer to deal with a business that has a physical presence rather than only a website, and they opened on a Saturday morning for about three hours and found new customers!

Their business was now a **'bricks & clicks'** operation**.** Sales success continued and they moved to a small factory which again brought unexpected benefits: more room to view large products; room to use a forklift to move heavy product packs thus saving their backs; packaging larger loads means more sales volume, sales were up so they could employ a third person for administration and finally their shop sales increased from 5% to 15%.

These unexpected benefits come from a key concept from organisation design called **'complementarity'** which involves the interactions among changes in different variables in affecting performance[6].

| **Mentoring Problems Encountered** |
|---|
| Need a business plan |
| Organisation needs privatising |
| Need (more) consumer traffic: Little sales |
| Valuing products/services |
| Start-up business concepts help |
| How to grow the business |
| Manufacturing companies: 'No Work' |
| Need an attitude change |
| Managerial fraud |
| Pricing help |
| Promote confidence in entrepreneur |
| Need finance |

*Figure 4. Some common Problems encountered*

## Conclusions

The importance of small business is undeniable as it is a major part of the economy with about a third contribution to GDP; it provides employment for about 5m Australians and is responsible for about 300,000 small businesses starting up per year.

Mentoring makes small companies stronger as well as train entrepreneurs to become better managers. The secret is for mentors to obtain a result from the mentoring; i.e., improve profitability or revenue and to solve any problems.

SBMS has been going for about 25 years and has given help and advice to more than 15,000 small businesses. It is also an inexpensive service for small companies and does not compete with providers of professional services. The author's experience covers a wide range of problems and companies and encompasses both manufacturing and service organisations.

Finally, the problems the author encounters is similar to the ones he encountered 30 years ago and because management is (apparently) not a progressive science, the same dilemmas and difficult trade-offs crop up time and time again.

## References


[1] Department of Innovation, Industry, Science & Research, *Age* Business Day, 12 March 2010, Page 2/3.

[2] 'Small business owners don't do it for the money', James Thomson, *Smart Company* briefing, 26th September 2008.

[3] 'Business Failure & Change', *Productivity Commission*, I.Bickerdyke, R.Lattimer & A.Madge, December 2000.

[4] 'What is the survival rate for new firms?', *USA Department of Commerce*, Bureau of Census, 2000.

[5] Schumpeter, 'Remembering Drucker', *The Economist*, 21st November 2009, page 70.

[6] *The Modern Firm*, Oxford University Press, John Roberts, 2004, page 32 – 51.

# Upcoming Conferences & Exhibitions

### Essentials of Inventory Control

**22 November 2010**
**APICS NSW Chapter, Suite 1, 111 Phillip Street, Parramatta**
**www.nsw.apics.org.au.**

**Topics covered include the following:**

Inventory functions; Inventory replenishment; Forecasting; Warehouse management & DRP; SCM & purchasing; JIT & TQM, trends in inventory management

**Who should attend?**

Participants of this course would be those inexperienced in managing inventory or who would like to understand the theoretical aspects of their role. The course will also be useful for those considering undertaking the APICS qualifications.

**Outcomes**

- Learn fundamental principles and techniques of inventory management
- Understand your role and responsibilities in the control of inventory
- Discover the impact that inventory can have on your business

Workshop Format

This workshop will include interactive elements and participant numbers are limited to ensure real learning and understanding. You will benefit by working side by side with others to review issues, explore concepts and identify solutions.

### Second Australasian Ground Control in Mining Conference 2010

**23-24 November 2010**
**The University of New South Wales,**
**Kensington Campus, Sydney NSW**

The Second Australasian Ground Control in Mining Conference follows the first Conference held in 2003 and is aimed at practical mine site operators, technical support staff, geotechnical engineers, mining engineers, consultants and researchers in the field of mining geomechanics and ground control. The Conference will provide an update to all mining industry geotechnical personnel best practice in both Australasia and overseas, and an information exchange vehicle between the coal and metalliferous sectors of the industry, with a focus on new technologies and developments; industry needs and mine site problem solving; and practical case studies.

### Practical Process Control workshop

**Melbourne: 2 & 3 December**
**Sydney: 6 & 7 December**
**Brisbane: 9 & 10 December**
**www.idc-online.com**

If you want to gain a clear, practical understanding of the essentials of process control and loop tuning, as well as how to optimise the operation of your plant or process then you should attend this workshop, says IDC Technologies.

Each attendee will receive a PC based simulation package which can be modified to suit individual applications.

At the end of this workshop participants are said to be able to:

- Understand the fundamentals of process control and new techniques
- Tune PID control loops
- Correct stability problems
- Understand cascade loops and feed forward control
- Identify and correct problems with dead time in the process

### EcoForum Conference & Exhibition

**9-11 March 2011**
**Sydney**
**www.ecoforum.net.au/2011**

EcoForum is a conference designed to bring Australian environment industry practitioners and their clients together to solve environmental problems and act on potential business opportunities.

EcoForum is an annual, multi-disciplinary environment industry event that encourages participation, provides real solutions and business leads and facilitates discussion and knowledge sharing on issues of concern, the organisers claim.

The 2011 conference will take place for three days from 9 to 11 March. In 2011, EcoForum will comprise five conference streams – climate change mitigation, water cycle sustainability, waste and resource recovery, land and groundwater remediation, communication and engagement – a boutique exhibition of environmental products and services plus a host of social and business networking activities.

Visit the EcoForum Conference & Exhibition website to register: www.ecoforum.net.au/2011

### CleanScene Expo 2011

**5-7 April 2011**
**Melbourne**
**www.cleansceneshow.com.au**

CleanScene will run from 5 to 7 April 2011 in Melbourne. It has support from the National Cleaning Suppliers Association, the National Upholstery, Carpet Cleaners & Restorers Association, the Association of Contract Cleaners and now BSCAA. The NUCCRA CleanLink conference will be co-located with CleanScene, while the ACCA is promoting the Expo to its members.

### IAHR 34th Biennial Congress

**26 June – 1 July 2011**
**Brisbane Convention Centre, Brisbane, QLD**
**www.iahr2011.org**

Including the 33rd Hydrology and Water Resources Symposium - 10th Hydraulics in Water Engineering. The Congress theme 'Balance and Uncertainty: Hydraulic Engineering in a Changing World' focuses on the central roles of hydraulic engineering, hydrology, and water resources for our changing world, and how these roles link to the broader issues. A balance is continually being sought between competing values in water engineering, including the environment, the economy, tourism, social and indigenous values, health aspects, aesthetics, and the needs of current and future generations. Careful management and innovative solutions are required to balance these competing values, and these solutions must be able to deal with the uncertainty in the natural world as well as the changing human world.

Engineers Australia and its National Committee on Water Engineering (NCWE) are collaborating with IAHR to organise the 34th IAHR Biennial Congress together with 33rd National Hydrology and Water Resources Symposium and the 10th National Conference on Hydraulics in Water Engineering.

## ASEAN Australian Engineering Congress 2011

**25-27 July 2011**
**Kuching, Sarawak, Malaysia**

**Engineering for Sustainability**

The ASEAN Australian Engineering Congress 2011 (AAEC 2011) is hosted by Engineers Australia, Malaysia Chapter and Swinburne University of Technology, Sarawak Campus with support from Sarawak Development Institute. The ASEAN Australian Engineering Congress 2011 (AAEC 2011) aims to foster excellence in the practice of 'Engineering for Sustainability'.

This Congress presents an opportunity to consulting engineers, researchers, designers, contractors, local councils, implementing government agencies and suppliers to discuss sustainable engineering solutions for the advancement of economic growth while preserving the fragile environment. The Congress provides a forum to review knowledge, disseminate information, promote awareness, facilitate collaboration, and make recommendations on the role of engineering in responding to delivering sustainable solutions. Innovative engineering projects and potential solutions will be presented in the form of technical presentations to encourage constructive discussions and to also provide a networking opportunity amongst university lecturers, students, staff of government implementing agencies and practicing consulting engineers. There will be an outstanding program of international and local speakers to present solutions to some of our most pressing problems on 'Engineering for Sustainability'.

The Conference Program will focus on six themes to be presented by reputable speakers: Planning & Policy; Climate Change; Sustainable Buildings & Infrastructures; Green Technology; Sustainable Waste and Water Management; Community and the Environment.

## World Engineers' Convention 2011 in Geneva

**4-9 September 2011**

**International Conference Center Geneva (CICG), Switzerland**
**info@wec2011.org**

September 2011 will see Geneva become the key international venue for engineers. The World Engineers' Convention 2011 (WEC 2011) seeks to encourage innovative engineering aimed at solving the problem of globally sustainable use of energy.

How can we provide sufficient energy for everyone around the globe? How can we meet the energy needs of the world's population fairly? How can we prevent conflicts over energy? These are just a few of the burning issues to be addressed by WEC 2011.

The title of the convention, Engineers Power the World – Facing the Global Energy Challenge, reflects its focus on energy as one of the greatest challenges of the 21st century. It will promote sustainable use and identify future-proof solutions in the areas of mobility and transport, urban development and construction, energy conversion, logistics, renewable energy and storage, and rational end use and large consumers.

Following on from Hanover (2000), Shanghai (2004) and Brasilia (2008), this will be the fourth WEC. More than 2000 delegates from 100 countries are expected in the host city of Geneva. The convention attracts decision-makers from all over the world: Nobuo Tanaka, Director of the International Energy Agency based in Paris, Professor Hiroshi Komiyama, President of the University of Tokyo, and Professor Chris Edward from Stanford University have already signed up as keynote speakers. "Everyone interested in thinking outside the box about energy will take inspiration from WEC 2011 in Geneva", concluded Daniel Favrat, EPFL Professor and Chair of the WEC 2011 Program Committee, speaking at the WEC 2008 closing ceremony in Brasilia. "WEC 2011 isn't just for engineers, it's also for representatives of business, government and education".

The convention will provide a major opportunity to gain an overview by reviewing, discussing and sharing engineering opinion. Its broad perspective will extend beyond scientific and technical aspects to consider ways of influencing the socioeconomic and political framework. Sharing policies, technology transfer, the North-South divide and the need for creativity and entrepreneurial activities will also not be forgotten.

Alongside the energy theme, WEC 2011 also aims to raise the profile of the engineering profession. Young people should see engineering as an attractive career option. The general public needs to gain a better understanding of the importance of engineering in achieving prosperity and tackling the big challenges of the future.