New Engineer JOURNAL

Servicing Manufacturing, Industrial Engineering and Engineering Societies

In this Issue

- Two Major Problems with Accounting and Management Systems in Manufacturing Businesses
- If You are Going to Talk Make it Interesting (aka 'A Life Among Aliens')
- The World's Newest Profession: Management Consultancy in the Twentieth Century
- The Future of Australian Manufacturing
- Value for Money and the Decision Environment
- On Performance Theory and the Desirability and Goodness of Productivity of Process

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Front Cover: A light hearted cover in sync with this edition's invited article 'If You are Going to Talk, Make it Interesting' by Dr Patrick Moriarty.

FORMAL PAPER REVIEWS
Leading papers published in this Journal are 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.

"Industrial Engineering – a great career and a way of life".

In this edition's Federal President's report, Lex Clark updates us on his continuing efforts to bring the IIE into closer contact with Engineers Australia and the perceived benefits in doing so. He is mindful of the relative positions and the strengths and weaknesses of each professional body and sees how closer co-operation between the two will bring on-going and possibly new mutual benefits. He concludes with the words: "Industrial Engineering - a great career and a way of life." I agree.

In this edition's lead article *"Two Major Problems..."*, John Blakemore returns to the author's stable with a contribution that deals with problems he sees with current management accounting practice – particularly in the manufacturing industries. He presents two mini case studies, each with some sample, normalised data. The first case study is concerned with a 'produce to inventory' situation whilst the second deals with a 'produce to demand' situation. Both cases illustrate the problems associated with gross margin calculations and consequent unprofitable mismanagement of assets.

The second and invited paper in this edition of **New Engineer** comes courtesy of Dr. Patrick Moriarty of Monash University – a hint of which appears prominently on this edition's front cover. Paddy's paper, titled *"If You are Going to talk ...,"* focuses more on how to prepare to speak publicly rather than actual delivery. The paper includes guidelines, amongst other things, on those sometimes pesky aids called power-points!

The third article is a **book review** (and a first for the **New Engineer** under this editorship) that is reflective of the management consultancy phenomenon of the 20th century. Titled *"The World's Newest Profession ...."* the 2006 publication is as informative today as when published. Principally, it explains how the early work of Taylor, Ford, the Gilbreths, et al greatly influenced U.S. Government decision making pre-, during and post-WWII, and how this further translated governmentally and commercially into Europe, the Philippines, Middle East (and no doubt Australia) in the latter half of the 1900's. As with John Blakemore's article, this review re establishes the fact that early industrial engineering has had (and hopefully continues to have) significant influence on many areas of decision making, viz, accountancy, management consultancy, etc.

Australian Manufacturing continues to be a topical point of discussion. So the report by John Blakemore, on one of the events of the May 2013 National Manufacturing Week event in Melbourne, titled *"The Future of Australian Manufacturing"* is timely. It was a panel-driven discussion with audience participation and covers issues such as Does Manufacturing Matter, the Role of Government, the High Australian Dollar and more. The 'snap-shot' of views and comments makes for interesting reading.

The fifth and penultimate article, *"**Value for Money** and the Decision Environment,"* is the third in the series of the same name by Lex Clark. In this paper, Lex expertly demonstrates the essence of resistance to change and how to overcome such barriers. In its own way, the article also shows how closely industrial engineering is linked to practical (shall we call it industrial) psychology and how hand-in-hand success is so often dependent on the knowledge and co-operation of others to effect real and meaningful change (Editor's bias).

Last in this edition is the editor's next instalment of *"**On Performance Theory**..."*. In this paper, emphasis is placed on the improvement of productivity through the MAXimising of desirable productivities and the minimisation of undesirable productivities – both arguably necessary to effect true positive change in an ever challenging and warming world.

Dr. Damian Kennedy,
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Institute of Industrial Engineers Australia Federal President's Report

www.iie.com.au

Over the last six months, I have been interested to watch the ongoing discussions on social media between Industrial Engineers, who are discussing their various individual issues and problems. These often seem to centre around:-

- How do I get a job in my discipline of Industrial Engineering?
- Why does no one seem to understand what Industrial Engineers do anymore?
- How do I get some information on a particular Industrial Engineering problem I have.
- I love being an Industrial Engineer.

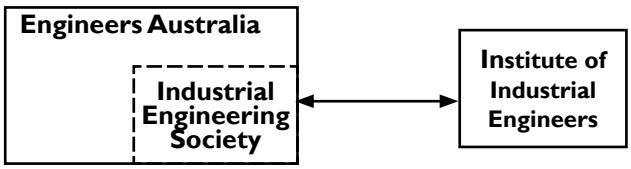
Thanks to the social media sites such as 'Facebook' and 'LinkedIn', we can see these issues being discussed all over the world in real time. Australia seems to be no different, even though we are:-

- Geographically a large country (about the size of the US without Alaska) and on the edge of the Pacific surrounded by the economies of China, Indonesia, Korea, Singapore and the United States - just to mention a few.
- We have a relatively small population (23million) together with a relatively small number of Industrial Engineers (maybe around 2,000 or more) scattered throughout a range of industries, which often are headquartered overseas.

So being an Industrial Engineer in Australia has its ups and downs like for everyone, everywhere else. At the moment, it might seem that there are more downs than ups as our economy struggles with its manufacturing industries and corporate decision making seemingly to be increasingly made overseas.

Yet, in this increasingly competitive global economy, it might seem that Australia should be crying out for Industrial Engineers with their focus on efficiency, productivity and the people who make this happen. Industrial Engineers are still on the Federal Government's list of essential skills required.

So this is the background to the reasons why this year we have again commenced to re-connect ourselves to the Institution of Engineers Australia (IEAust better known today as 'Engineers Australia') with its approx 70,000 members of all Engineering disciplines. We will not loose our independence as an Incorporated body of Industrial Engineers, but we will provide the voice of Industrial Engineering as the Industrial Engineering Society of Engineers Australia.



As the changes start to take place, you as members of IIE will need to be aware and help in the process. As they develop, you will start to see over the coming months, changes that include:-

- Going on to the large Engineers Australia database – some of you who have IIE membership numbers starting with 2001 to 2013 (egg. 2004003) will shortly be asked

Your President as a very young Industrial Engineer in the 1950s Australian aircraft industry with de Havilland Aircraft, which became Hawker de Havilland in the 1960s and is now Hawker de Havilland Aerospace within Boeing Australia.

to provide your birth date as Engineers Australia use this to distinguish between members with the same name.

- A new membership online application and renewal system – in the financial year 2014/2015 (not the next one about to come 2013/2014), you will receive your membership subscription through the Engineers Australia system.
- A new IIE website (www.iie.com.au) operated in connection with the Engineers Australia website (www.engineersaustralia.org.au) – it is through this link that opportunities for jobs and promoting IE will be expanded.
- A stronger and more visible Industrial Engineering link to the other 70,000 Engineers Australia members which includes over 20,000 student members – the opportunity to explain IE to, and make contact with, many other Engineers.
- A redevelopment of our IIE links with overseas Industrial Engineering organisations from the much more powerful Engineers Australia base – this involves present Agreements of Cooperation as well as new communications with some large IE organisations who have had a tendency in the past to try and take us over.

If, as good Industrial Engineers, you have ideas and suggestions for ways that you believe your Institute can be redeveloped and support you as Industrial Engineers in Australia and overseas, please do not hesitate to contact me or other members of the Board.

Industrial Engineering – a great career and a way of life.

Lex Clark
FIEAust CPEng FIIE, FIVMA
President Institute of Industrial Engineers Australia

Two Major Problems with Accounting and Management Systems in Manufacturing Businesses

Dr. John Blakemore masc@blakemore.com.au

Introduction

There are a number of common problems that inhibit the potential speed of innovation and growth of small medium enterprises (SME's) particularly manufacturing companies.

They are:

- Not correctly managing the skill set of their employees
- Lack of a clear well defined strategic business plan
- Poor recognition of the fundamentals of quality, cost and delivery
- Not defining and using effectively their Strategic Advantage for Winning (SAW).
- Lack of capital.
- Poor management.
- Poor understanding of the fundamentals of the profit and loss account and the balance sheet.
- Late financial information
- The use of outside accounting assistance and advice from people who do not understand the business.

This paper will attempt to deal with the accounting issues caused by the poor structure of the accounting profit and loss account and balance sheet in SME's and finish by asking a series of simple questions that beg answers.

Fundamental problems in the accounting system

- Poor use of the available people professional skills
- Standard Costing
- Not linking Inventory costs with manufacturing costs for made to stock lines (MTS).

Over the last 30 years in particular I have performed many assignments on a wide range of companies, from $5M turnover to $1.3 Billion turnover. What follows are real examples of recent assignments both aimed at redesigning and re-engineering the management system to restore profitability. The names of the companies must remain confidential but the results are true and the data is normalized to protect their identity.

The first case is an illustration of poor people management and a poor understanding of the links between marketing strategy and inventory holding costs and manufacturing costs. This company was transformed from a loss of $0.5M to an EBITA of $40M with another $18M released from finished goods inventory and waste reduced by $2.5M.

For the second case the company was losing approximately 5% on sales of approx. $100 Million and this could be restored to a profit of approximately 6% EBITA on sales with a redesign of the accounting system so that the CEO is aware of where he is making money and where he

is losing money, and a rationalization of the products which was held back by the accounting anomalies.

Case 1: Inventory costs

Figure 1 is an illustration of what can happen when the link between stock movement and stock holding costs are not included in the calculation of net profit. It is a plot of Sales, Inventory, Gross Margin Actual, if the inventory cost is included in the cost of goods sold. This means re-defining and re-calculating Gross Margin.

This company was making a loss of approximately $0.5M per year until this problem was exposed and solved. Then, sales of high volume lines surged and available manufacturing time (that was in the past used to make items that would not sell and were then held in stock) was released to make more of the high sales lines since the demand had not been previously satisfied.

The net result of this was that sales soared, capital was released for innovation and paying off debt and the EBITA soared to $40M EBITA in 2.7 years.

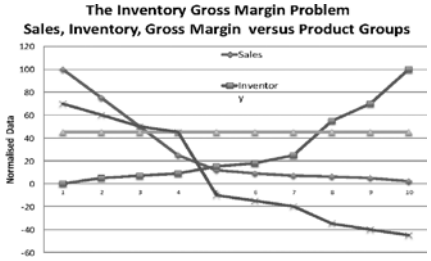


Figure 1. An illustration of how inventory costs can erode an assumed net profit

Case 2: Standard Costing

Figure 2 is an illustration of what can happen when a standard costing system is used. In this case the product range is showing that the gross margin is approximately constant and independent of the product type.

It is an illustration of how standard costing systems can distort the strategies needed to drive profitability. It is a simple graph of the gross margin claimed and the real gross margin. In this case all product was made to order so that the inventory problem in case 1 did not interfere with the data.

When the real manufacturing cost was determined by abandoning standard costing, then it was clear that the company could not make certain lines at a profit and these unprofitable lines were (again, as in Case 1) using up valuable production time.

Questions for business schools

In the two cases above, the CEO's were all trained at University level and had MBA graduates working for them. In one case three Directors had been working on the inventory control problem for 5 years and had made no progress. Again, the three Directors were all University trained with accounting management and engineering training with MBA's working directly for them.

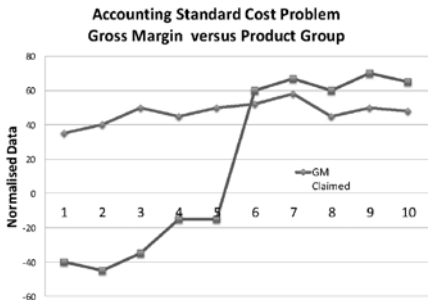


Figure 2. An illustration of how a standard costing system has hidden the real gross margins

For the second case, the CEO was an Engineer with a highly qualified accountant working for him directly and numerous other graduates, one an MBA reporting directly to him.

Therefore, the fundamental question is the 'Julius Sumner Miller' one "Why is it so?" Perhaps readers of this article may like to offer suggestions and remedies. Why aren't our University trained managers able to solve such simple problems?

Conclusion

This paper raises some serious issues about the management of Australian businesses and the general usage of accounting systems and the methods used by the business managers in making decisions. In case 1, a $300M turnover company, the CEO and his Operations Director and the Financial Director had been working on the problem as a team for 5 years and made no progress. How much had this cost the shareholders and employees?

In case 2, a $100M turnover company, the company was returning a massive loss at the time of the study. This should not have been the case.

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If You are Going to Talk, Make it Interesting (aka 'A Life Among Aliens')

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1. Introduction

Time and date: Thursday afternoon, November 19th 1863. Four and a half months after the Battle of Gettysburg (5000 dead horses—where were the RSPCA that day?—and 7500 dead humans), the Soldiers' National Cemetry at Gettysburg is being dedicated. (Gettysburg, a town of under 2500 souls, which had hosted the battle, hit upon the then-novel idea of getting Federal money to help pay for the environmental clean-up.) Edward Everett, former Secretary of State, Governor of Massachusetts, President of Harvard University, and vice-presidential candidate etc etc is invited to give the address. A famed orator, he speaks for 2 hours to a 15,000-strong audience, and his talk is apparently well-received. (15,000 hmms..: 7500+2500+5000 = 15,000—I hope this is a coincidence.) Abraham Lincoln is on the program merely to give Dedicatory Remarks. He speaks for 2-3 minutes, and starts with the words:

Four score and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty, and dedicated to the proposition that all men are created equal…

Whose talk do we remember today?

There are several lessons here. First, size is not everything. Leave the audience wanting more, don't just keep going on and on until you—and your audience—are exhausted. Second, it helps if you have something important or interesting to say. Third, you don't have to use **powerpoint** to make a lasting impression.

I'm assuming that nearly all of you reading this article are used to public speaking—after all, industrial engineers are often called upon to present ideas, etc. to audiences of all constituancies and interests. So I'll concentrate on how to make your talk more memorable and interesting, not on how to overcome nerves. If you are still nervous in front of people, check out the books in the 808 Dewey section of your local library, or—God forbid!—hire a personal trainer. (Be warned: most of the books on giving presentations in the 808 section assume that you want to sell something to somebody—there are other reasons for giving talks.) We all have problems to overcome in public speaking. I speak too fast—I think too fast!—and I have a slight speech defect.

Some general points. Who am I going to be talking to? What's their English like? Check the list of conference attendees—their names and affiliations will give you some idea. If English is likely to be a problem—as in an overseas conference held in English—you may need to have 'subtitles' for your talk, i.e. give the essential narrative material on overhead slides or even handouts, and stick to plain English.

Get into the mind of your audience—what do they want from this talk, what do they already know, what will interest them? What's their background knowledge on the topic? Some topics like transport are of interest to a wide range of professionals: designers, economists, psychologists, planners, geographers, environmental activists—as well as civil engineers. So, a heterogeneous background, and you have to hold the interest of all of them. Monitor their reactions; if they look as though they know the material already, introduce more provocative material. Don't be boring—life's too short to listen to boring talks.

Check out the venue for the talk—will they all be able to hear you? Can you operate the lights, computer, etc? Are there jackhammers in operation nearby? The worst type of venue is one sometimes used for conferences—a deep auditorium with people scattered here and there in the dark (because it's assumed that you're all going to use powerpoint.) It might be the same venue as that used for plenary sessions. At a 2005 conference on biomass energy, there were two parallel sessions. I was given the smaller room, but had the larger audience, so some people had to stand. The organisers apologised, but I explained that the audience atmosphere was far better than in a half-empty larger auditorium. If you can, try to get your time slot early in the conference, on the first day if possible. If not, try to get the first spot in a session. Avoid the last day if a three (or more) day conference—everybody else will.

2. Demon rum

You're an after dinner speaker, or at least a speaker at a function at which alcohol is served. You might think it will steady your nerves if you have something to drink. My advice—wait until after your talk. When I gave an address at my sister's 70th birthday function at HTC (Heidelberg Theatre Company), I gave what I hoped was a humorous

talk, and thought I could at least get the occasional smile. The audience had made use of the free bubbly etc, I hadn't. Audiences usually want you to succeed, and the educated, older, 150-strong audience greatly appreciated the talk, as shown be their reaction. By the way, I worked on the talk (on and off of course), for several months. Don't expect to write a good talk the night before.

3. *Happiness is a warm caring family—in another city*

You've been asked to talk at a family gathering eg at a milestone birthday, or at a wedding, wedding anniversary etc. Clearly, many or even most of the audience will be known to you. The idea is to give anecdotes that demonstrate you know well the person being honoured. You can make them slightly embarassing, but not highly embarassing. (Of course, what's embarassing varies with the audience—you could presumably talk about someone's fixation on his mother if the audience were all psychoanalysts.) On the other hand, I've heard that at some 21st birthday parties, so-called friends have had the person honoured in tears. Always remember: all of us are only one really good insult away from a nervous breakdown. Try to make people feel good about themselves, don't trash them.

4. *Opening your talk*

- The Wearing of the Green—given at Melb Uni on St. Patrick's Day three years back. Talks were limited to 3 minutes each—and timed with an egg-timer and a guy on drums who came in very softly at 3 minutes, and then progressively louder. I started with the point that unlike two centuries ago when the tragic events inspiring the song were written, green is now a very fashionable colour. The two meanings of the word 'Green'. Along with everything else anyone, anywhere, has ever done, it's on YouTube somewhere. (By the way, a similar borrowing occurred with a number of articles using the phrase from Kermit the Frog: It's not easy being green. A recent Google search showed over a quarter million hits for this phrase. It's become a cliché.)
- The view from 2050—I started this talk to a U3A (University of the Third Age) lunchtime forum by advising all those in the forecasting business to pick a time well into the future—2050 for example—not a couple of years hence. You'll be wrong both times, but in 2050 either you won't be round, or they'll have forgotten. (This talk was published in Sept-Oct 2006 *Aust. Quarterly*). The prophecies of retired civil engineer Harold Camping support this point. He predicted 'the rapture' was to occur on 21 May at 6 PM in 2011, but then postponed it to 21 October 2011. (It didn't happen.)
- My oldest sister's 70 birthday address—I first posed the problem: where do you start with the influences on a person's life? I started with the origin of the solar system, some 4.6 billion years ago.
- Edge Theatre 2008—I used the analogy of cargo cults. The audience gradually realised that the "island" in South Melanesia was Australia, and that the large village which had fervently adopted the cargo cult idea was Melbourne. (I capitalised on the fact that Western anthropology consists of our reflections on 'native' (ie alien) practices, not on our own, to introduce a surprise element.)

A Monash *press release* we (myself and academic colleague Damon Honery) put out in March 2008 was a summary of a couple of our recently-published papers. It contained the memorable and quotable phrase by my co-author Damon Honnery 'the car is doomed'. The press release was taken up by hundreds of websites worldwide over the following weeks, mostly right-wing US sites who thought we were "assholes". It beats being ignored! All the websites without exception contained the phrase 'the car is doomed'. If we didn't have a phrase like that, the press release would have been ignored. Between the two of us we gave over 20 radio interviews, and were commissioned to write short articles for 'Australasian Science' (10 minutes after the press release went into the Aether, and with the title 'Cars are doomed') and 'Green Living'. We were also invited to write a book for Springer and several chapters for edited books.

A little on a related topic—titles for papers, books, exhibitions etc. After all, at a conference, your paper title will be your talk title. The title is the first summary of the paper. Make it short, informative, and memorable. It's worth spending a lot of time on finding your title. On my computer I keep an updated list of possible titles as they occur to me.

One measure of interest for Elsevier journals is their 'Top 25'—based on downloads for each quarter. We (again my long-time colleague, is Damon Honnery from Mechanical and Aerospace Engineering, Monash Uni.) have done well on these rankings, and good titles are an important reason. Example: What energy levels can the Earth sustain? Our book for Springer has the title: Rise and Fall of the Carbon Civilisation. Clearly, this borrows from William Shirer's 1960 book The Rise and Fall of the Third Reich: A History of Nazi Germany, which in turn borrows from Edward Gibbon's late 18th century The History of the Decline and Fall of the Roman Empire. It's OK to modify famous titles for your talk, book, paper, show etc. Nevertheless check it out in Google. I thought Stealing from the future would be a great title for one of our papers until I checked the phrase in Google—and found thousands of entries. So it's become stale, and no longer arresting.

My autobiography has the following two proposed titles —don't worry, I don't plan to write one (I don't have any dirt on anyone famous):

- So Who's a Clever Boy Then?
- A Life Among Aliens.
- The actual title of a biography on my namesake (former

head of the Irish Electricity Board) was called: Paddy Mo: The Life of Patrick Moriarty 1926-1997.

5. Some great book titles:

* Installing Linux on a dead badger.
* Get out of my life, but first could you drive me and Cheryl to the mall;A parent's guide to the new teenager.
* In me own words: The autobiography of bigfoot.
* She got up off the couch: And other heroic acts from Moorland, Indiana.
* Well-behaved women seldom make history.
* DIY dentistry and other alarming inventions.
* Pride and Prejudice and Zombies by Seth Grahame-Smith, Jane Austen.
* An Arsonist's Guide to Writers' Homes in New England by Brock Clarke.
* I Still Miss My Man, But My Aim Is Getting Better by Sarah Shankman.
* I Gave You My Heart, But You Sold It Online by Dixie Cash.
* Are You There, Vodka? It's Me, Chelsea. by Chelsea Handler.
* Women Are from Venus, Men Are from Hell by Amanda Newman.

And a sad one I saw in my local library:

* I just want my pants back.

An article on time-keeping officials in athletics:

* These are the souls that time men's tries…

And of course, the ones you already know—

* To Kill a Mockingbird
* The Hitchhiker's Guide to the Galaxy etc

But already, the zombies theme is being overdone.

A talk needs a strong start, to get the audience hooked, as I've tried to illustrate above.

You could also give an outline of what you plan to talk about. Southern Baptist preachers reputedly announced at the start of the sermon that they were planning to preach against sin A, B and C. So if the preacher had just finished with sin B, you knew what was coming next—and how much longer you had to sit there. It also needs a good finish—don't just say 'and that's it', or somesuch. Give them a hint that you're winding up, and then deliver a final point with punch. You also need a strong body of the talk too. (Helpful aren't I? Strong opening, body of talk, finish.) Use vivid, concrete images to get your ideas across. Argue a thesis—don't just drift.

6. Yes children, there's life after Powerpoint?/Don't take my security blanket away!

We move along from 1863 to 1870. The first Vatican council has just proclaimed the doctrine of Papal Infallibility—on July 18. Lord Acton was not happy about it, and coined his famous dictum: "Power Corrupts. Absolute Power Corrupts Absolutely". Edward Tufte, a graphic design guru, wrote a paper critical of Powerpoint for Wired magazine (or Weird magazine, if you don't happen to live in California), Issue 9/2003, entitled 'Power Corrupts. Powerpoint Corrupts Absolutely', an obvious but clever takeoff of Acton's comment. A talk is more than rearranging your power point slides. If you just use power point slides, then anyone could have given your 'presentation'. Why should they come along to hear you? Nick Morgan in his book Working the Room (another good title, and it's in our library) argues: Indeed, most PowerPoint presentations are in fact speech outlines put together for the speaker's benefit, not the audience's. So you can use Powerpoint judiciously, but don't let it take over.

7. Humour

Yes it's allowed. But don't just tell a joke with no relevance to your theme—if it falls flat it's embarassing. If you use humour to reinforce one of your main points, then even if the audience don't get the humour (or, more likely, do, but don't think it's very funny), you've still made a good point. If you do tell a joke, make sure it's plainly relevant to your theme. Stay away from the usual Politically Incorrect jokes (which are, of course, most of them)—assume the Thought Police are always listening.

8. Speak to the truth

Above all, your talk, unless it's sole purpose is to entertain, and perhaps even then, make sure your data are correct and your arguments are well supported by evidence.

9. Finally, getting noticed

About 20 hours of material are loaded onto YouTube every minute, and a million videos uploaded onto the net daily. I put the word 'the' into Google—over 25 *billion* pages were returned. And that's just in English. So it's getting ever harder to get people's attention. If you are a researcher, artist or designer (and that includes engineers), you should have come up with something interesting or controversial that you can talk about. To get it noticed, make sure you present it in the best possible way. Remember, most talks are endured, not enjoyed, and to repeat: Life is too short for boring talks.

The World's Newest Profession: Management Consulting in the Twentieth Century

(New Engineer Book Review)

Christopher D McKenna
Cambridge Studies in the Emergence of Global Enterprise Cambridge University Press 2006.

I was recently looking through the student bookshop at the University of New South Wales in order to find some interesting texts, which were apparently of interest to todays up and coming Industrial Engineers.

After looking through the small and somewhat uninteresting engineering section, I found myself in the much larger, more interesting business and accounting section. I say 'interesting' only in regard to the apparent emphasis in the bookshop on management and accounting which has been a basis behind much Industrial Engineering development over the years.

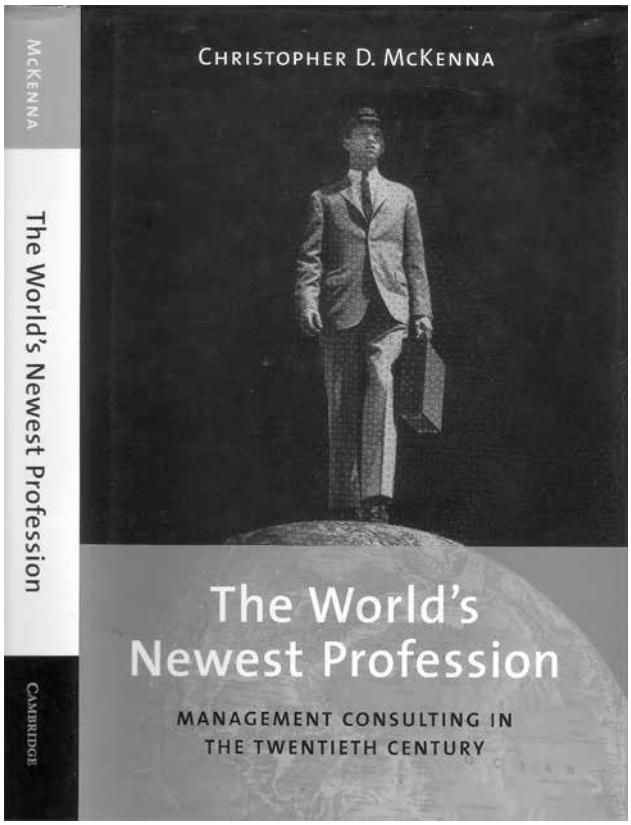
On one shelf I came across the hard cover book which is the subject of this review. Why was it of interest you ask? Because it is basically an analysis of the history and application of Industrial Engineering and Management Consulting over the last 100 years...

Where does its name "The World's Newest Profession" come from? Is this because of the outstanding achievements and esteem in which its practitioners are held for their work over the last 100 years? Unfortunately not! Based on the excellent work of Industrial Engineers and others in the first half of the Twentieth Century, the thesis is that the practice of Management Consulting, which evolved largely after World War II, became so lacking in ethics and morals that its reputation became more closely aligned with that of the "Worlds Oldest Profession". I say this with no disrespect intended to the world's oldest profession.

Yet in the Introduction to this book is the question, asked in 1999, "how it had come to pass that nearly one-third of top MBA graduates and one-sixth of all elite under-graduates (whether at Oxford, Yale, etc.) now begin their working lives as management consultants." Nicholas Lemann in 'The New Yorker' mused about what he called an "extraordinary development in the history of Western culture. The United States had decided "in effect, to devote its top academic talent to the process of streamlining the operation of big business". (Pages 2-3).

The Early Days

The story of consulting is started at the end of the Nineteenth Century (late 1800s) not with Frederick



Taylor (early 1900s) developing scientific management, but with the electrochemical engineers at the Massachusetts Institute of Technology (M.I.T.) who helped spearhead the "second industrial revolution" (page 29). Giant concerns such as Standard Oil, General Electric and AT&T realised that by employing engineers, they could control the pace of innovation within these science based industries.

Frederick Taylor began his career as an engineer in 1874, where his hands-on training as an apprentice machinist influenced his emphasis on the productivity of labour in the traditional industries of iron and steel. Taylor's research focused on those workers whose jobs could not be paced by the assembly line. Thus, Taylor's system was always intended to work alongside, not overlap, the Henry Ford system of mass production. Both Taylorism and Fordism sought to simplify tasks and pace industrial workers. Scientific management was soon represented by the self-trained engineers, such as Frank Gilbreth and Henry Gantt. Between

1901 and 1915, scientific management was introduced to nearly 200 American businesses and had defined the subject (pages 37-38).

By the 1890s, both in the United States and Great Britain, engineers and cost accountants were commonly working in tandem on the increasing use of statistics, budgets, estimates and forecasts, all of which require engineering and accounting methods. Thus, between 1889 and the late 1930s, engineers and accountants, particularly in the United States, had fashioned a new professional jurisdiction. These worked both as internal and external organisation consultants.

World War II

World War II placed incredible demands on both industry production and organisational skill, 'Taylorism' and 'Fordism' (so called) could be expanded to provide huge industrial production outputs, and by 1940 the US federal bureaucracy (the Government) was encouraging the use of outside consultants as organisation problem solvers.

The extensive use of outside management consulting firms in government fundamentally reshaped the US administrative state into a contractor state. Through their reorganisation of Federal Departments and Agencies, the management consultants institutionalised a reliance on outsiders to solve organisational problems.

During the War, consulting firms such as Booz, Allen and Hamilton received many and large contracts with the US Army, Navy and War Production Board (the US did not have a separate Air Force at this time). While there were many small studies such as office space needs and reorganising the internal postal system for the Navy, there were other significant studies such as the reorganisation of the Office of Naval Operations.

The use of internal and external consultants both had their advantages and disadvantages, particularly with the military. However, the use of external consultants had become institutionalised, and with the end of the War this was expanded across American society.

After the War

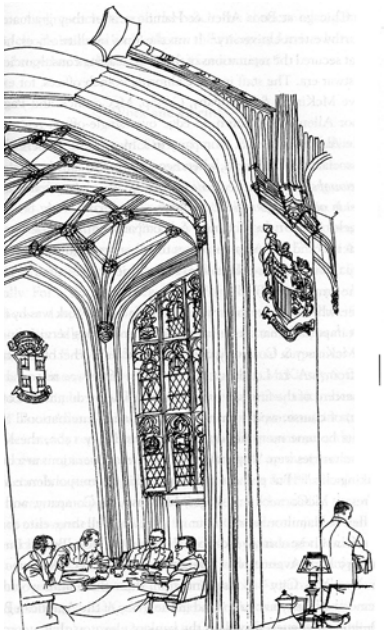
In 1948, under the auspices of the Marshal Plan (a US system to rebuild a shattered Europe); the United States began sending engineers and executives to Europe as advisors under the Technical Assistance Plan. While focussed on engineering skills and technology, it also funded management training, executive seminars and American technical consultants.

This transfer of management consulting information and services between the US and Europe had, of course, been going on before the War. By 1956 in Britain, four Taylorist firms (PA Consulting, Urwick Orr, P.E. and A.I.C) controlled three-quarters of the consulting market. In the US, however, only a few Taylorist firms managed to stay in business by the 1950s.

Beginning in 1956, American companies began to reinvest in their European subsidiaries, and US management consulting firms followed. US management consultants were hired to help European businesses become as efficient as their US competitors, while also hiring them to help keep out these competitors! In 1957, Royal Dutch Shell Oil asked McKinsey and Company to form a new multidivisional organisation. McKinsey had already expanded their international activities in the Philippines (1953), Egypt (1953) and Iran (1956).

Many other management consulting firms expanded their activities across the globalising world, and management consulting was developed and expanded further as a highly prestigious profession.

The Newest Profession



Consultants from George Fry and Associates at their University Club

The author of this book starts his Introduction with a talk to one of his Master of Business Administration (MBA) students who he was supervising as a teacher of strategy at the University of Oxford's Said Business School. The man, in his mid-twenties, explained that he had a range of managerial experience in companies before he decided to pursue an MBA. However, he was having difficulty finding a job, and could he be offered some advice or contacts.

"My initial response was simple and reasonable, or so I thought. Given his work experience and the fact that he was so clearly a superb general manager, why wasn't he looking for a challenging job within an industrial company that would suite his newly acquired MBA? The student smiled at me and indulged my naïveté by replying that if he had really wanted another job in industry, why would he have spent all this time and money to acquire an MBA? The MBA, after all, was the de facto qualification for an elite position within a professional services firm and, therefore, a job in general management was obviously a waste of the potential value

of his hard-earned degree."

In the second last Chapter (9) of this book, the author finally recounts the sad and disastrous tale of the collapse of Enron in 2001. How investigators explicitly linked the management consulting firm Arthur Anderson with a conflict of interest between the firm's $27 million in management consulting fees for Enron and the $25 million that Anderson received for its audit work. The Wall Street Journal highlighted the fact that more than 85% of the Dow Jones Industrial companies "paid their auditors more for consulting, tax and other services than for the company audit". For example, recall also the not too dissimilar scandal-ridden demise of such organisations as WorldCom and Parmalat!!

While the apparent elitism of the young MBA student above may be only one aspect of the decline of ethics and morality of the management consultancy profession at the end of the Twentieth Century, it would seem a long way from the application of engineering discipline, practices and principles applied with great success up until the middle of the 20th Century.

Comment

While this book has been very briefly reviewed because of its interesting and informative Industrial Engineering history content, it also provides some useful background to the evolution of Industrial Engineering and management consulting in general in Australia. In some respects, we can see a little better why we are where we are today and how Industrial Engineers might help to renew their role in the Australian and global economy.

Bookworm
24 May 2013

We seek your contributions to the **New Engineer** *Journal*

- recent articles, programs, blogs, etc. you think are topical and should have wider exposure
- your feedback on articles that have appeared in the **New Engineer** Journal
- articles on topics you think should appear in the **New Engineer** Journal
- 'other' – your chance to be **creative** !

Please send your contributions to the editor:
Dr. Damian Kennedy at rdk4567@gmail.com

The Future of Australian Manufacturing

National Manufacturing Week Panel Discussion
Thursday 9th May 2013

John Blakemore PhD FIEAust CPEng CMC FAICD

Introduction

Reed Business and Reed Exhibitions, who organize National Manufacturing Week (NMW), supported a panel discussion on the future of manufacturing in Australia which was organized and facilitated by myself. My invited panelists included one of the best manufacturers in Australia, Frank Seeley, a well known economist and CEO, Craig Milne, an academic, Professor Chris Davies, a former GM of a Toyota subsidiary, Gary Stewart, and a Director of the Institution of Industrial Engineers, Bill Ferme. I was there in my capacity as former Director of Reed Business.

Agenda and Format

A list of potential items of importance was displayed to the audience in no particular order and the audience was asked to pick a topic for debate from the list, or, add another topic if they wanted to.

This list is given below:

1	Setting the Scene Australia's strengths and weaknesses in a global context
2	The World and market economic outlook
3	How significant is the strong A$?
4	Is Australia a special case?
5	Does Australia have any competitive advantages?
6	What happens to our massive reserves of natural gas, uranium, bauxite, coal, food production and sunlight?
7	What is innovation?
8	Does the Government understand R&D and Innovation?
9	Why is our output of scientists and engineers poor?
10	What is the CSIRO doing?....DICE.
11	Have we capitalized on the opportunities created by climate change?
12	What industries should we support and should we pick winners?
13	What are we good at?
14	Do the global mining giants care about what is in the national interest?
15	Does manufacturing matter?
16	We need a vision, leadership and a plan.
17	How can we build a better value adding future?

These are now discussed in the order chosen by the audience as follows with abbreviated comments from the panel members. Time did not permit discussion of all the above topics.

Does Manufacturing Matter ?

- Manufacturing is crucial to any civilized country…it is the central core for the success of any country (FS)
- Manufacturing adds wealth to the service industries
- Manufacturing is the core of all progressive societies
- It makes the world go around
- All innovation results from manufacturing
- Manufacturing innovation creates wealth
- Innovation in manufacturing drives wealth creation
- Manufacturing makes a country strong
- Manufacturing creates technology (CD)
- It depends on who you ask
- The people in Canberra think it doesn't matter at all
- Manufacturing is the basis of the security of the nation

What should the government do?

- If we are relying on government then we are lost (FS)
- There is a pull and a push (CD)
- The thing that matters is what the industry is doing
- The government is crucial (BF)
- If the government opts out then we are doomed
- Research costs money ...
- SME's need help, they need to be educated in management and R&D
- Australia is a high cost country (CM)
- In the Holden commodore the labour cost is $12,500 per car the labour cost in Thailand would be $2,000 (CM)
- We need tariff protection
- How many people know about the NMW exhibition? (FS)

Does Australia have any competitive advantages ?

- Yes Innovation
- Our education system is a competitive advantage
- One of our advantages is our small size
- USA companies are very slow

- We are not good at innovation
- Australian is 23rd for innovative skill in a recent list of developed countries in the world and going down fast
- We are not good at small volume production

Audience

- How can small companies improve.. I am not interested in broad brush answers
- The MBA dumbs you down (GS)
- Put knowledge back into the human being
- Innovation requires effort
- Education in world competitive manufacturing is needed.
- Do not confuse short run scheduling with short run production
- Design out the labour
- I would be thoroughly depressed if I thought it (the MBA) was dumbing down our students (CD)
- Look at the complexity of the gear sample created by 3D printing (handed around (JB)
- Innovation involves ingenuity

What is Innovation?

- Insight
- Ingenuity
- imagination
- Newness
- Inspiration
- Seeing it but doing it differently
- It is the commercialization of business ideas
- It takes a ling time to go from the idea to successful commercialization
- In some cases the time frame even now is 23 years (GS)

The Effect on Manufacturing of the strong Australian dollar

- If you think that the high Australian dollar is the problem then you have a problem (GS)
- The problem is how you react to the Australian dollar (GS)
- Seeley is exporting successfully at A$=1.10 US. The reason is that Seeley gives the customer something that no other company can give (FS)
- The currency war is in progress world-wide
- The government has relinquished defending the Australian currency
- We all know that that real unemployment rate is 10% (CM)
- Samsung, during the GFC spent a fortune on R&D (JB)
- Honda is the only car company that made money during the GFC (JB)
- It is what happens at the firm level that is the most important
- Industry needs to get organized and let the Government know what is needed
- Why is Seeley successfull?... because it is working on products for the future (GS)
- We must value add (JB)

What is Australia good at?

- Medical Research (JB)

Product Development must drive the overall innovation process

- There has been too much emphasis on process not new products
- It is not what is happening now it is where they are going
- Honda design the product based on feedback (JB)
- It is about product development and then design the process to build the product
- The order is product development and then process innovation (FS)
- The secret of Toyota…take cost out of the design and the manufacturing process (GS)
- I wonder if Australia is good at product innovation (CM)
- The US is very good at dreaming up new products (CM)

We need a Vision Leadership and Plan

- We are a report generator but nothing is ever done (BF)
- The submarine is a real example of our incompetence
- Sitting people in a room to solve the problems of the Australian submarines is a very ineffective way forward.
- Government gave the contract to the Swedes the German tender was rejected
- The politicians once again made a very poor decision
- It is good to see that you are making U Boats again … a German reaction to our submarines (CM)
- We should build our own submarines and all our own shifts … we are an island.
- Australia was founded by the Royal Navy 225 years ago and despite this we do not have a shipbuilding industry.

Value for Money and the Decision Environment

Lex Clark
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The following article has been adapted from the Department of Defence publication Defence Reference Book DRB 37 "Value Analysis" (with permission and now out of print). Some of the phrases used might seem now to be a little "quaint", and a couple of the specific concerns are interesting, although now well known in the wider public arena. The use of the term 'Value Analysis' and the role of a 'Value Analyst' are, however, both in keeping with the Australian Value Management Standard AS4183:2007. In particular, they apply to anyone who is engaged in trying to achieve 'better Value for Money'.

Introduction

In the two earlier New Engineer articles on achieving better Value for Money in design[1] and procurement[2], I mentioned indirectly some of the difficulties which are experienced in getting good VA recommendations accepted and implemented. This of course applies to anyone who is questioning the present status quo and appears to be challenging earlier decision making. Industrial Engineers are no strangers to this issue. One of the most powerful disincentives is fear of change. While "fear" might seem to be a rather strong term, it does reflect the deep concern in individuals that can be caused by potential changes over which they feel they have limited control. At the end of this article (per addenda) is a well known list of twenty two ways in which to 'kill an idea'. While they may seem to be somewhat humorous, some are, unfortunately, only too commonly still in use today.

Decisions to Make a Change

The need to make changes can be many and varied. Internal programs such as "continuous improvement" are based around an environment where continuous improvements or changes are encouraged and implemented. External highly competitive environments may force changes to be made in order to counter competitive threats. Changes may be reactive to overcome problems, or they may be proactive in order to prevent problems. The environments in which changes can be readily made may include:

- The user's requirements have changed since the original decision on a solution was made.
- The original solutions or designs were made elsewhere (including overseas) where the requirements where different to the local requirements.
- Technology changes have made available new and improved solutions.
- Operational use over time has revealed the need to make changes.
- The need to reduce costs due to changed financial constraints or competition.
- The need to improve performance for a whole range of reasons, not the least of which is professional pride.

Change involves risk

That fact that people will resist change in many ways is beyond question. However, we need to understand why they do so in order to develop counter-tactics to circumvent or overcome some of the particular fears underlying their reaction. All change involves risk, which gives rise to the need for self protection by decision makers against embarrassment or even just additional work. Loss of face or even ridicule is injurious to decision makers. It can result in loss of prestige, peer esteem and even damage to career prospects.

Minimisation of personal loss and / or embarrassment

Many decisions are made on the basis of avoiding or minimizing personal loss - which could take the forms of reduction of authority, demotion, dismissal or plain (simple) embarrassment. We can all remember decisions we have made based on these self-protection criteria, not always with shame or regret and, in some cases, satisfaction at having avoided certain consequences we would perhaps rather not think about. The desire to avoid embarrassment is often stronger than an executive's desire to improve the competitiveness of his/her firm, and will even serve to perpetuate a wasteful practice or process with which he or she has been associated.

Value Analysis, due to its function oriented (questioning WHY before HOW) approach, has the capacity to cause embarrassment in a number of areas. Better value alternatives may bring loss to technical people, manufacturing, purchasing or anyone connected with the

present mode of doing the job, especially if it is so clear and straightforward that important people in management or decision making areas can see that it will probably work. Reactions can often be critical of those seen to be responsible for the original decisions that resulted in the present method, i.e. the one that the Value Analyst is trying to improve or eliminate.

Anyone who wants to practice Value Analysis successfully (which also means getting worthwhile changes implemented) must understand that the fear of loss or embarrassment is a **big issue**. Every step must be taken to minimise these. If the present (e.g. military) solution has "be made overseas", or a long time ago, there may be no one to blame for the now inappropriate or out of date decisions. Of course, if you are the person who made the original decisions, getting in early with the new proposal may only result in congratulations!

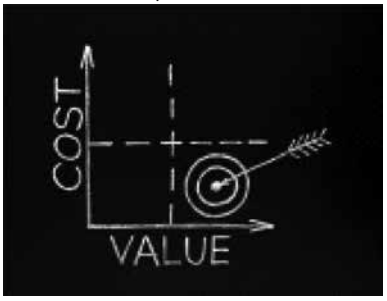
Useful counter-tactics

Many cases are on record where good money saving alternatives have been developed by VA techniques, and have been stopped, and their originators suppressed because of this fear, which is very real and in many cases justified.

In his book on Value Analysis, Lawrence Miles (3) tells of the company making heavy electrical equipment who used 458 metres of copper conducting bus bar as a winding for one of their larger products. They bought this heavy copper strip in lengths of 92 metres and, therefore, had to make four high quality brazed joints in it to form the continuous conductor - a costly and exacting operation. A Value Analyst questioned this practice, believing that such conductors were probably made in much longer lengths, but was assured by all concerned, including a technical executive, that 92 metres was the maximum length obtainable. Being rather determined to check all his facts, the Value Analyst contacted the copper company and was agreeably surprised to find that continuous lengths were not only available but cheaper because there was no need to cut it and packaging and shipping costs were reduced. As a result, the longer conductors were adopted and the cost of the piece of electrical plant greatly reduced.

The end of the story is not so fortunate however. As a result of retaliatory action by the executive who had been most embarrassed, the sphere of operations of the Value Analyst was greatly reduced and eventually VA was dropped altogether.

Using the principle that the end justifies the means, a suitable tactic in this case could have been for the Value Analyst to set up a harmless 'conspiracy' with the copper company by persuading them to write to the electrical equipment company



to say that they had changed their production methods and could now offer the material in longer lengths, with the possibility of certain economies by their customers and to their mutual benefit, and would be glad to know of any interest... etc etc. In how many circumstances do we find that engineering turns out to be the engineering of consent?

Be prepared

Whenever and wherever a VA recommendation is made, the following need to be studied:

a. What are the pressures that may ensure acceptance and implementation? How may these be optimized?
b. What are the pressures that may result in non acceptance? How can these be reduced?
c. Who will make the final decision and what are his / her likely motivations? Will they stand to personally gain or lose by the proposal?
d. If personal loss (due to embarrassment) is in prospect, how can we reduce? or eliminate this?

Some suggestions

1. Construct an escape route or face saver like, 'Recent changes in materials, technology, manufacturing methods, availability, cost etc. etc. (implying that the victim could not be expected to be aware, etc).

   or

2 'Perusal of very recent literature and reports by consultants operating in a similar field reveal that ...'

Allow time, after preliminary warning (which could be unofficial, leaked, friendly tip off, etc.), to enable people to 'modify their position'. This is an euphemism for admitting they were wrong in the first place without seeming so. Even if it only enables the decision maker to pre empt your recommendation by a week, the 'ridicule index' will be lessened. When a report is written, blows can be softened, provided that the Value Analyst can resist the temptation to show how clever he / she is.

The 'Law of the Situation' approach.

This is often used to great effect by enlightened decision makers in a difficult position, and could be of the form: "We currently have a product/system which we believe to be capable of considerable value improvement, to the benefit of our (and possibly customer's) efficiency and performance overall. Our only interest is in improving this situation. There are to be no recriminations and save for ascertaining vital benefits directly relevant to our stated intention, we are not concerned with how the situation arose or who might have been involved in it. These areas represent a waste of time and resources which we need to invest in our efforts to improve the situation."

The best way to improve the chances of a good VA proposal getting implemented is to be aware of the fears

which motivate resistance to beneficial change. It is worth going to some trouble to let people down as lightly as possible.

Overcoming resistance to ideas

The basic concepts and techniques applied as Value Analysis are fundamentally simple and appear to be rather obvious to someone who is suddenly presented with the proposals. However, to any new ideas, particularly when they appear to be so basic, resistance to change will commonly be met.

A. Management Resistance

(1) *Attitude* - There will be an increase in paper and time involved when the resources are already stretched to the limit.

Actually - The benefits to be gained in the long run far outweigh the initial involvement.

(2) *Attitude* - A belief that money saved will be money lost to the program or to next year's budget.

Actually - Correctly supported, the money saved may be used to expand the program.

(3) *Attitude* - A reluctance to let what appear to be outside investigations into their department.

Actually - Outside assistance only is given, and information is not disseminated unless requested.

(4) *Attitude* - A belief that a 'loss of status' may be involved when the work of their department is subject to outside criticism and 'second guessers'.

Actually - The results of the projects are entirely under the manager's control who accordingly 'gains in status'.

(5) *Attitude* - Apathy of management, resulting in a lack of understanding of results to be achieved and the potential of the method.

Actually - Actually, one of the greatest problems that Value Analysis programs have to overcome.

B. Technical Resistance

(6) *Attitude* - In a Defence environment, cost may sometimes not be so critical. If performance is poor, everyone knows. If delivery is late, everyone knows. But if cost is high, it is nothing out of the ordinary.

Actually - Value Analysis can assist performance and delivery times, as well as reducing costs. Costs are, however, assuming increasing importance.

(7) *Attitude* - Reluctance to employ a management technique that requires a direct soul-searching of their own creational processes.

Actually - The use of creative techniques will assist the average person to make much better and more satisfying decisions.

(8) *Attitude* - The feeling that management does not fully understand the technical function, and that cost reduction specialists will be given too much power and authority.

Actually - All power and authority remains under the control of the relevant authorities Value Analysis is only used to assist.

(9) *Attitude* - The worry that Value Analysis concepts can be easily downgraded to cost reduction only, which in turn can be corrupted to quality reduction a highly undesirable result in the Defence environment.

Actually - The whole basic concept of Value Analysis is function orientated, not cost. If anything, quality will be improved not reduced.

C. Contractor Resistance

(10) *Attitude* - Value Analysis in consultation with the Department will probably give large savings which in turn will give a reduced contract price and consequently a reduced profit.

Actually - The Contractor incentive scheme is designed to specifically increase their profits, while also saving the Department money.

(11) *Attitude* - Savings in consultation with the Department will give a physical reduction in sales value in an environment where total sales value is the success criteria rather than profitability.

Actually - The contract applies a proportioning system so as to convert savings into equivalent increased sales.

(12) *Attitude* - The belief that processing ideas and changes through Government Departments will cause too much extra work and delay.

Actually - Actually, a major problem, and the change proposal handling scheme must be designed to be as fast as possible.

Conclusion

This paper has an historical background but is as relevant today as it ever was in the past. It addresses the practical issues of implementing change against a background of very human emotions involving either perceived and / or very real risks of personal-loss by final decision-makers.

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2. Clark, A. L. G. (2012), Improving value for money (VfM) in Australian procurement, New Engineer Journal, Vol. 15 No.1 May 2012.
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Addendum: Twenty two ways to kill an idea...

1. Ignore it: dead silence will intimidate all but the more enthusiastic proposers of ideas.
2. See it coming and dodge: you can recognize the imminent arrival of an idea by a growing unease and anxiety in the would be originator. Change the subject or better still end the meeting.
3. Scorn it. The gently lifted eyebrow and a softly spoken, " You aren't really serious, are you?" works wonders. In severe cases make the audible comment, 'Utterly impracticable'. Get your thrust home before the idea is fully explained, otherwise it might prove practicable after all.
4. Laugh it off. 'Ho, ho, ho, that's a good one, Joe. You must have sat up all night thinking that up.' If he has, this makes it even funnier.
5. Praise it to death. By the time you have expounded its merits for five minutes everyone else will hate it. The proposer will be wondering what is wrong with it himself.
6 Mention that it has never been tried. If it is new this will be true.
7 Prove that it isn't new. If you can make it look similar to a known idea, the fact that this one is better may not emerge.
8. Observe that it doesn't fit company policy. Since nobody knows what the policy is you're probably right.
9. Mention what it will cost. The fact that the expected saving is six times as much will then pale into insignificance. That is imaginary money; what we spend is real. Beware of ideas that cost nothing though, and point out, 'If it doesn't cost anything, it can't be worth anything'.
10. "Oh, we've tried that before". Particularly effective if the originator is a newcomer. It makes him realise what an outsider he is.
11. Cast the right aspersion, "Isn't it a bit too flip?" or "Do we want this clever clever stuff? or "Let's be careful we don't outsmart ourselves". Such comments will draw ready applause and few ideas will survive collective disapproval.
12. Find a competitive idea. This is a dangerous one unless you are experienced. You might still get left with an idea.
13, Produce twenty good reasons why it won't work. The one good reason why it will, is then lost.
14. Modify it out of existence. This is elegant. You seem to be helping the idea along, just changing it a little here and there. By the time the originator wakes up, it's dead.
15. Encourage doubt on ownership. "Didn't you suggest something like Harry is saying when we first met Jim?" While everyone is wondering, the idea may wither and die quietly.
16. Damn it by association of ideas. Connect it with someone's pet hate. Remark casually to the Senior Man, "Why, that's just the sort of thing John might have thought up". The Senior Man loathes John. Your idea man doesn't and will wonder for weeks what hit him.
17. Try to chip bits off it. If you fiddle with an idea long enough it may come to pieces.
18. Make a personal attack on the originator. By the time he's recovered, he'll have forgotten he had an idea.
19. Score a technical knock out. For instance, refer to some obscure regulation it may infringe. Use technology as a bludgeon. "But if you do that you'll need a pulsating oscillograph coupled with a hemispherical interferometer so you see, there would be a negative feed back on the forward rheostat and you wouldn't want that would you?"
20. Postpone it. By the time it's been postponed a few times, it will look pretty tatty and part worn.
21. Let a committee sit on the idea.
22. Encourage the author to look for a better idea. Usually a discouraging quest. If he finds one, start him looking for a better job.

On Performance Theory and the Desirability and Goodness of Productivity of Process

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Abstract

This paper is based on an original paper published by the same author in *New Engineer*, Vol. 12, October 2009 (1). In the Introduction and body of both papers, is an expansion of the traditional notion of productivity to include the 'desirability' and 'goodness' of productivity, These hint, of course, that, the traditional role of the IE in 'improving productivity' should be expanded to include that of "eliminating (or at least minimising) bad and / or undesirable productivity".

The paper concludes with a summary of practical guidelines relating to the elimination of bad and undesirable productivities of process, and how to set appropriate levels of MAXimising Goal values and minimising goal values in order to achieve superior levels of productive system performance.

Keywords

Productivity. Desirable Productivity. Good Productivity. Bad Productivity. Undesirable Productivity. Maximising Goal. Minimising Goal. Utility-Productivity Performance Equation. Goal values.

Introduction

Traditional industrial engineering has always focused on "productivity" and its continuous improvement. This implies somewhat that 'productivity' is of a singular nature to be "industrially engineered". However, within any productive system, there are many processes operating simultaneously off a set of input resources with each process individually generating a set of temporal and spatial output resources (over time). That is, a productive system has many processes, each characterized by a set of its own "many productivities".

Definition of 'Productivity'

Salvendy's (2) definition of singular *productivity* - as a measure of '*output-to-input*', is a starting point that can be used in an expression for the set of productivities of an individual process (represented by the symbol $\{\eta_{process}\}$, and can be expressed in the following form:-

$$\{\eta_{process}\} = \frac{\{output\}}{\{input\}} \qquad (1)$$

- where, $\{\eta_{process}\}$ is the set of productivities of a single process, $\{output\}$ is the set of outputs emanating from the process and $\{input\}$ is the set of inputs (variable and house) available to the process.

Component Productivities of $\{\eta_{process}\}$

Figure 1 shows the simple representation of a productive system:-

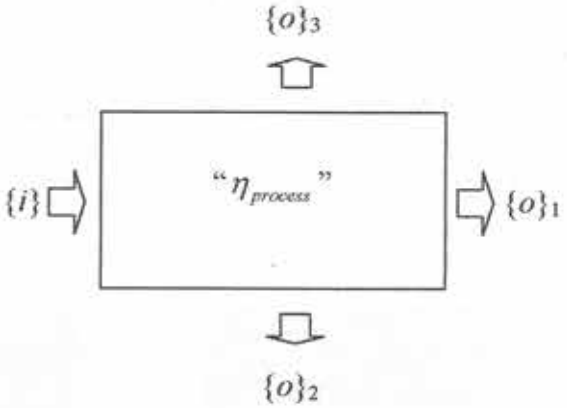

Figure 1: Productive system process with one set of inputs $\{i\}_{j=1}$ but three sets of outputs $\{o\}_{k=1,2,\text{and } 3.}$

Figure 1 suggests that input resource set $\{i\}$ and productivity of process $\eta_{process}$ collectively combine to produce a singular set of output resources "$\{o\}$".

However, as shown in Figure 1, **three** sets of outputs – one ***desirable set*** $\{o\}_1$ and two, ***undesirable sets*** $\{o\}_2$ **and** $\{o\}_3$ typically emanate from a productive system.

Set $\{o\}_1$ represents that set of *desirable* outputs (desirable products and services) while sets $\{o\}_2$ and $\{o\}_3$ represent sets of *undesirable* outputs (undesirable waste and pollution products).

The *desirable* set of output resources $\{o\}_1$ constitutes those products and services expected and *desired* of the productive system.

Output sets $\{o\}_2$ and $\{o\}_3$ are, however, not desirable. Output sets $\{o\}_2$ and $\{o\}_3$, in practice, represent *undesirable* or "pollution" sets. While output set $\{o\}_2$ typically represents land and sea pollutants, set $\{o\}_3$ typically represents air-borne pollutants – both *undesirable* sets of outputs.

Figure 1 also shows that the following productivities of process must, therefore, exist:-

Desirable productivity $\eta_{desirable}$
Desirable productivity is defined as that set of desired output resources $\{o\}_1$ produced from the set of input resources $\{i\}$. That is,

$$\eta_{desirable} = \frac{\{o\}1}{\{i\}} \qquad (2)$$

Contained within $\{o\}_1$, however, are both good $\{o_1\}$ and bad $\{\bar{o_1}\}$ products and / or services. Thus, ***good productivity*** can be defined as:-

$$\eta_{good} = \frac{\{o_1\}}{\{i\}} \qquad (3)$$

And, ***bad productivity*** can be defined as:-

$$\eta_{bad} = \frac{\{\bar{o_1}\}}{\{i\}} \qquad (4)$$

- where,

$$\frac{\{o\}1}{\{i\}} = \sum[\eta_{good} + \eta_{bad}] = \frac{\{o_1\}}{\{i\}} + \frac{\{\bar{o_1}\}}{\{i\}} \qquad (5)$$

Undesirable productivities $\eta_{undesirable}$
Undesirable productivities are defined as those sets of output resources $\{o\}_2$ and $\{o\}_3$ produced from the same set of input resources $\{i\}$. That is, to "complete the threesome", productivities of process associated with waste and pollutant outputs can be defined as follows:-

$$\eta_{undesirable} = \frac{\{o\}_2}{\{i\}} + \frac{\{o\}_3}{\{i\}} \qquad (6)$$

The Utility-Productivity Performance Equation and the Improvement of the Productivity of Process

Desirable Productivity: Assuming that the productivity of interest is the *desired* productivity $\eta_{desirable} = \frac{\{o\}1}{\{i\}}$, then the utility-productivity performance equation has the following MAXimisinG-goal form:-

$$P_{p=\eta_{desirable}} = \frac{\eta_{a_{desirable}}}{\eta_{G_{desirable}}} = \mu_{g_{desirable}} \eta_{a_{desirable}} \qquad (7)$$

- where $P_{p=\eta_{desirable}}$ is the *Performance* measure and where the performance-parameter of interest p is *desired* productivity $\eta_{desirable}$.

- $\mu_{g_{desirable}}$ is the desired goal utility value of input resource. (and $\eta_{G_{desirable}}$ is the desired Goal value of the productivity of process)

- $\eta_{a_{desirable}}$ is the actual desired productivity of process.

Equation (7) suggests that when goals have been set for the utilities of the input

resources, every effort needs to be made to realise a MAXimum actual *desirable* productivity of process. This will help to achieve the overall goal of maximising the (*desirable*) productivity performance of a productive system.

Desirable productivity and good quality utility of input resource: When the utility of the input resource is of the right nature and of good quality, then maximising the use of such resource will only maximise the production of desired, and *good*, units of output $\{o_1\}$.

Therefore, to MAXimise the production of $\{o_1\}$, it is required that the performance-parameter of interest p becomes the *good* productivity of process. i.e. $p = \eta_{good} = \frac{\{o_1\}}{\{i\}}$ (Equation 3)

The goal, of course, must be to MAXimise η_{good} with the resultant productivity performance measure becoming:-

$$P_{p=\eta\ good} = \frac{\eta_{a\ good}}{\eta_{G\ good}} \qquad (8)$$

And, the utility-productivity performance equation becoming:-

$$P_{p=\eta\ good} = \mu_{g\ good} \cdot \eta_{a\ good} \qquad (9)$$

- where $P_{p=\eta\ good}$ is the *Performance measure* and where the performance-parameter of interest p is *good productivity* η_{good}.
- $\mu_{g\ good}$ is the goal value of the *good* utility of the input resource due to the good quality of the input resource (and $\eta_{G_{good}}$ is the goal value of the good productivity of process)
- η_{agood} is the actual value of the *good* productivity of process.

Equation (9) suggests that once goals have been set for the *good* productivity of the process, every effort needs to be made to MAXimise the actual good productivity of the process. This, in turn, will result in the maximum production of good units o_1 and the maximum production of good outputs $\{o_1\}$. That is, Equation (9) directly suggests that there is a real need to raise actual good productivity levels above set goal values.

Desirable productivity but poor quality utility of input resource: When the utility of the input resource is of the right nature but not of good quality, then maximising the use of such resource will only maximise the production of desired, but *not good*, units of output $\{\bar{o}_1\}$.

Therefore, to minimise the production of $\{\bar{o}_1\}$, it is required that the performance-parameter of interest p becomes the *bad* productivity of process. i.e. $p = \eta_{bad} = \frac{\{\bar{o}_1\}}{\{i\}}$ (Equation 4)

The goal, of course, must be to minimise η_{bad} with the resultant productivity performance measure becoming:-

$$P_{p=\eta bad} = \frac{\eta_{gbad}}{\eta_{abad}} \qquad (10)$$

And, the utility-productivity performance equation becoming:-

$$P_{p=\eta bad} = \mu_{abad} \cdot \eta_{gbad} \qquad (11)$$

- where $P_{p=\eta bad}$ is the *Performance measure* and where the performance-parameter of interest p is *bad productivity* η_{bad}
- μ_{abad} is the actual value of the *bad* utility of the input resource caused by the poor quality of the input resource (and η_{abad} is the actual bad productivity of process)

- η_{gbad} is the minimising goal value of the *bad* productivity of process.

Equation (11) suggests that once goals have been set for the *bad* productivity of the process, every effort needs to be made to minimise the actual bad productivity of process. This, in turn, will result in the minimum production of bad units $\{\bar{o}_1\}$ and the maximum production of good outputs $\{o_1\}$. That is, Equation (11) directly suggests there is a real need to lower actual bad productivity levels below set goal values.

Undesirable productivities: When the performance-parameter of interest is the *undesired* productivity $\eta_{undesirable} = \frac{\{o\}2}{\{i\}}$ or $\eta_{undesirable} = \frac{\{o\}3}{\{i\}}$, then the utility-productivity performance equation has the minimising- goal form:-

$$P_{p=\eta_{undesirable}} = \frac{\eta_{g_{undesirable}}}{\eta_{a_{undesirable}}} = \mu_{a_{undesirable}} . \eta_{g_{undesirable}} \quad (12)$$

- where $P_{p=\eta_{undesirable}}$ is the *Performance* measure and where the performance-parameter of interest p is *undesirable* productivity $\eta_{undesirable}$.

- $\mu_{a_{undesirable}}$ is the actual value of the *undesired* utility of input resource (and $\eta_{a_{undesirable}}$ is the actual value of the *undesired* productivity of process)

- $\eta_{g_{undesirable}}$ is the goal value of the *undesired* productivity of process.

Equation (12), therefore, suggests that once goals have been set for the *undesired* productivities of process, every effort again needs to be made to realise a minimum actual *undesirable* productivity of process. This will also help achieve the overall goal of MAXimising the (*undesirable*) productivity performance of the productive system. This point is further elaborated upon by the following comments:-

1 In equation (12), $P_{p=\eta_{undesirable}}$ will be at a superior performance level ($\geq$ 100%), when $\eta_{a_{undesirable}} \leq \eta_{g_{undesirable}}$.

2 Recall that any input resource has the potential to be used to produce undesirable output(s) (1). Thus, the resultant actual *undesirable* productivity of process ($\eta_{a_{undesirable}}$) needs to be reduced below minimising-goal value ($\eta_{g_{undesirable}}$) in order to realise superior (*undesirable*) productivity of process performance.

Engineering Guidelines for MAXimising Desirable Productivity of Process

In order to **MAXimise** *desirable* productivity, strict quality control ***in the usage*** of all categories, types and quantities of resources contained within $\{i\}$ **and** strict quality control ***in the execution*** of all *process(es) in general* is required to eliminate the $\{\bar{o}_1\}$ component of $\{o\}_1$.

That is, given that the set of input resources $\{i\}$ consists of both variable and house resources, it is ***poor quality usage of both types of input resources*** *(variable and/or house)* that inevitably end up in generating the bad or poor quality outputs $\{\bar{o}_1\}$. It is only through strict conformance to quality standards associated with the ***usage of variable input resources*** (labour, materials and various input utilities) and strict conformance to quality standards associated with the ***usage of house resources*** (plant and equipment) that such outputs can be minimised and, at the limit of '100% conformance to usage standards performance - for both variable and house

input resources, can $\{\bar{o}_1\}$ be eliminated from $\{o\}_1$.

Engineering Guidelines for minimising Undesirable Productivities of Process

In order to **minimise** undesirable productivities, however, focus must be shifted to the *inherent potential of any input resource (variable and/or house)* to produce undesirable outputs $\{o\}_2$ and/ or $\{o\}_3$ (1).

It is only through very careful initial selection and/or refinement of input resources that undesirable productivities can be eliminated. That is, the selected and used input variable resources need to have minimal potential to produce any form of adverse outcome, and the selected, used and *maintained* input house resources similarly need to have minimal potential to produce such adverse outcomes. In short, labour, direct materials, plant, equipment and indirect (maintenance) materials standards need to be set at the highest levels and met and, again, strict adherence to all operational standards need to be set at the highest levels, and also must be met.

In brief, it is the *undesirable potential* components of the input resource set that result in pollution (in all its forms) of land, sea and air (1). If such components cannot be minimised/eliminated through initial selection and subsequent usage of such resources, then it is through the exploitation of follow-on recycling capabilities and strict conformance to recycling standards - that such outputs can be minimised and, again, at the limit of '100% fitness for purpose' performances, both $\{o\}_2$ and $\{o\}_3$ can indeed be eliminated.

Engineering Guidelines in the Setting of minimizing goals and in the setting of MAXimising Goals

To realise higher levels of *desirable and/or good* productivities, reasonable (*'paid-for'*) goal levels ought to be set for the utilities of all categories, types and quantities of input resources and all effort must be made to realise MAXimum actual productivities of process(es). This approach will MAXimise *desirable* outputs by minimising the actual amount of individual input resource required per unit of *desired* output produced. By exceeding set utility goal levels, superior productivity performance within a productive system will always be achieved.

To realise lower levels of *undesirable and/or bad* productivities of process, *stretch* goals ought to be set for the productivities of process, and all effort made to minimise any undesirable components of utility associated with any category, type and quantity of input resource. This approach will minimise undesirable outputs by minimising the potential utility of any input resource to become or produce undesirable output(s). Again, meeting or exceeding set goal levels will always result in superior productive system performances.

Conclusion

The ***overall goal*** of industrial engineers and ***industrial engineering*** should be ***to design and facilitate the management of superior performance level productive systems.*** That the overall focus should always be on the attainment of ***superior levels of performance against known and deliberately set goal values*** - not only for the improvement of *good* productivity but also for the minimization/elimination of all bad and undesirable productivities of process - has been argued in this paper.

References

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