ABSTRACT

In the environment created by events leading up to the Federal Government’s Innovation Summit, the potential impact of quality understanding by industrial R&D managers on implementation is reviewed. In particular the current trend in industrial R&D in Australia reported by various sources is assessed, and the consequent effect on the potential contribution of Quality Management to the implementation of Summit outcomes is considered. The level of understanding of quality concepts of industrial research managers has been assessed by evaluation of their responses to a questionnaire on quality. Also their assessment of quality understanding at a number of levels in their organisations is illuminating, and conclusions can be drawn from their answers. These responses are examined in the context of the industrial R&D structure and the current R&D environment in Australia. The likely impact of the Innovation Summit is discussed in the light of the quality understanding of industrial research managers, given the key role that industrial R&D must have in any outcome which is designed to maximise the benefit to Australia from increased innovation.

Keywords: Innovation, Quality, Industrial R&D, Quality Concepts, Quality Understanding

1 Introduction

Following a rise in awareness that innovation in Australia is not as healthy as it should be and that a high level of innovation is essential for sound economic growth, the Business Council of Australia (BCA) and the Federal Government are sponsoring an Innovation Summit in February 2000 in Melbourne. Its aim is to improve the performance of Australia in the field of innovation. There are several accounts by participants of plans for the Summit, the environment in which it is to be held and its follow-up. (Donaghue 1999, Buckingham 1999, BCA 1999a), but whatever its outcome is, the industrial R&D sector will be critical to successful implementation.

2 Trends in R&D in Australia

A study by the Business Council of Australia, BCA (1999b) BRW (1998), drew attention to the fall in R&D expenditure following the reduction in the R&D tax concession in 1996. It had been growing at 13% per annum, but this changed to a decline of 9% after 1996, with greater falls in the future predicted by the respondents to the BCA study. Such a turn around is a serious concern. Those that attribute this to removal of syndication may not be in touch with what is happening in industrial R&D in Australia.

Although in the current period, the economic indicators are looking better, the future looks difficult for Australian industrial R&D. Australia’s investment in the future is being reduced through cutting back on industrial research, both in the number of laboratories and the number of staff in those laboratories. The Industry Commission Report (IC1995) finds that the return to the whole economy of R&D can be very high.
This makes it even more important for Australia to be at international best practice levels in all aspects that affect industrial research. Quality is an obvious area that needs to be targeted, as large benefits are achievable in return for modest efforts.

The most recent picture of R&D in Australia comes from a survey done by the AIRG in preparation for their submission (AIRG 1999) to The Australian Science Capability Review, which is being conducted by the Chief Scientist for the Federal Government. It says in part ....

"The twenty five industrial companies covered by the AIRG telephone survey conducted between November 25th and December 3rd 1999 employ 2314 scientists/engineers in R&D. They represent over 60% of the companies represented in AIRG. Sixteen of the members (64% of the sample) reported that the number of R&D scientists/engineers in their company had decreased over the past five years. The total number of R&D scientist and engineer jobs lost over the past five years was in excess of 1336 or around 40% of the number of the R&D scientists and engineers employed in those companies five years ago. (Figure 1)"
Since 1336 scientists and engineers employed in R&D in Australia have lost their jobs over the past 5 years and only 238 jobs have been gained, the net job loss is 1098, bringing the numbers in November 1999 down to 2314.

R&D reductions were often proportionately larger in companies with large R&D efforts. For example “Three companies with a high percentage reduction in R&D staff (> 30%) were major employers of R&D scientists/engineers (Figure 2)”.  

**Figure 2  Extent of R&D downsizing % and loss of R&D staff**

One is reminded of the old saying ….

*“The most profitable time a company can have is between cutting R&D and going out of business”*

In the longer term, financial benefits can come from reducing costs caused by poor quality practices, so improving quality should be seen as a way of making the R&D dollar go further, not as a dispensable cost when financial pressures are applied.

### 3 Potential Contribution of Quality Management

The long-term benefits, which can be derived from applying basic quality management processes, are evidenced by spectacular changes. Take for example the two nations, *Japan* and the *USA*.

After the Second World War, the USA was the only major industrial country whose manufacturing capacity had not been devastated. So strong was their position in the global market it seemed that they could sell everything they could manufacture. Industry did not need the quality methods and tools that they had learned, so many were unused and forgotten.

In contrast Japan had a huge task of rebuilding. With very limited manufacturing plant available they first attempted to compete on price, so “Made in Japan” meant shoddy. They then took a radically different tack … they listened to people such as Deming, Juran and Sarasohn.

In 1967 Juran made the prediction (Juran 1967) that “The Japanese are heading for world quality leadership, and will attain it in the next two decades, because no one else is moving there at the same pace”
Although the Japanese economy has had its difficulties recently, Japanese industry did dominate the world economies for decades.

For example, …

In a customer satisfaction survey for cars in the USA reported in 1986 (Power 1986), Japanese cars filled three of the four top rating spots. The first US made cars were rated at Number 5 and Number 12. This was 19 years after Juran’s prediction of what would occur within 20 years!

There has not been a colour television set made in the USA by a US manufacturer for decades. “Made in Japan” became synonymous with quality!

That basic quality principles were applied in Japan decades ago, and bore fruit, is evidenced by a study done by the Boston Consulting Group (BCG 1986). This study showed that as manufacturing processes to make a product became more complex, so the labour required in the USA became greater than that needed in Japan. In the most complex case considered, automobile manufacture, the Labour Index (USA hours/Japan hours) rose to nearly 2!

Many studies had been done overseas on what worked when applying the quality approach to Industrial Research and Development.

In Miller (1995), a survey of 45 companies in North America, Europe and Japan was used to identify 10 practices that were used most often in managing for quality in R&D. The article discusses the uneven penetration of quality practices and how different firms apply quality to their R&D function. It concludes that fundamental quality principles are applicable to R&D but analyses the unique approach needed.

Davidson (1996) identified the factors and practices which differentiated organisations with continuing successful and pervasive quality programs from those with waning or abandoned programs. No one approach was successful, but some had a higher probability of success than others.

In Wood (1993) the factors important to implementing TQM in an R&D environment were identified. The importance of leadership by management is stressed, which is interesting given the low understanding of quality of senior management, as perceived by some R&D managers.

Some further studies were limited to one company. The study by Keiser and Blake (1996) is of particular interest to those working in R&D because it reports on how the Nalco Chemical Company had difficulties applying standard quality approaches to research, so modified their approach in a structured way leading to successful acceptance. Patino (1997) also reports on how quality approaches were adapted to fit an R&D environment at Coors Brewing. The emphasis here is on defining what is meant by the “quality terminology” used in a research context and on increasing the understanding of this by the people in R&D.

Given that the quality of industrial R&D in Australia is critical to successful implementation of the outcomes of the Innovation Summit, the understanding by IR&D managers of basic quality is also critical.

4 Understanding of Quality in IR&D

A survey has been conducted with the participation of members of the Australian Industrial Research Group (AIRG), exploring the attitudes to quality of industrial R&D managers. This paper concentrates on the levels of understanding, and misunderstanding, that were apparent from responses to the questionnaire. The AIRG is comprised of heads of private industry research organisations in Australia. Collectively they manage the majority of industrial research in Australia. As such they are in a pivotal position to drive the application of initiatives coming from the Innovation Summit.

In 1993, the AIRG established the theme for its year’s meetings as ‘Quality in R&D’. (AIRG 1993). In these sessions it became clear that few of the industrial research managers had a sound working knowledge of basic quality principles. (one of the authors was President of the AIRG during that year) Such information is anecdotal by nature, so this survey was designed to place this knowledge on a more quantifiable basis.

The contractionary environment for industrial research and development in Australia at the time this survey was conducted, has continued and become even more pronounced. The membership of the AIRG has fallen from over 100 to a little over 70. Of these about 45 are currently active in managing industrial research.
(This is a good indicator of the “health” of the IR&D sector, as most of the recent resignations have been driven by the substantial reduction of the R&D function in the firm.)

In this environment many IR&D managers are under extreme pressure, so quality efforts are often forgotten while issues affecting short-term survival are dealt with. When the reduction in the number of industrial research laboratories is coupled with concomitant reductions in size of research groups, the capability of IR&D in Australia is in steep decline. A preliminary report of the results of this study into attitudes to and understanding of quality amongst IR&D managers in Australia. It was presented at the Third International and Sixth National Research Conference on Quality Management in Melbourne in February 1999 [Harvey (1999)]

5 Industrial Research Quality Study

Aims
This study was designed to investigate:
- The current status of quality in industrial R&D
- The perceived knowledge of the participants.
- Quality programs that have been used.
- The perceived need to increase understanding of quality
- The perceived need to increase application of quality

This paper focuses on the consistency of responses and the implications of understanding of quality principles on initiatives to improve the innovation process.

Methodology

Interviews
Preliminary interviews were conducted with a limited number of current and recent industrial research managers.

Pilot questionnaire
Then a questionnaire was developed and trialed on a somewhat larger group of industrial research managers.

Questionnaire
A final questionnaire was then drawn up which probed the respondents’ and their organisations’...
- Understanding of quality principles
- Application of quality principles
- Perceived need to improve
- Use of resources to improve quality
- their perception of...
- The effectiveness of those quality activities tried
- Perceived constraints
- Perceived drivers
- and if a current program was operating to improve quality.

The questionnaires were distributed to all current AIRG members (except those who have been retired for many years).

Survey Response Statistics

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Questionnaires distributed</td>
<td>67</td>
</tr>
<tr>
<td>Returned questionnaires</td>
<td>38</td>
</tr>
<tr>
<td>Unwilling to participate as response was seen as inappropriate</td>
<td>7</td>
</tr>
<tr>
<td><strong>Total Responses</strong></td>
<td><strong>45</strong></td>
</tr>
<tr>
<td>AIRG members who are currently managing a research facility</td>
<td><strong>45</strong></td>
</tr>
</tbody>
</table>
5 Outcomes of the Questionnaire

An analysis was done of responses to the questionnaire.

Factors such as the priorities given to quality concepts, the perceived understanding and application of quality at the scientist level and at the senior management level, the usefulness and effectiveness of specific quality programs and the impact of quality programs on Research and on their Company. This analysis showed the understanding of basic quality principles by industrial research managers to be disturbingly low. The current analysis was directed at inconsistencies in the responses. Consistency does not mean a sound basic quality understanding, as important concepts could all be rated as of low importance. Such a response is quite consistent.

Response Inconsistency

In this analysis, the priorities assigned to basic quality concepts were compared. Of course the lowest difference was “1”, where concepts were placed together in the Priority List in the response and so is quite consistent. A higher number shows an inconsistency. (i.e. 1 – consistent, 2 and higher – increasing inconsistency)

For example, a respondent who understands basic quality concepts would be expected to rate “Concentrate on the Process” and “Continuous Improvement” as having similar importance.

In this case 21 of the 38 respondents rated “Concentrate on the Process” and “Continuous Improvement” as having similar priority, but 17 did not!

In this case 21 of the 38 respondents did not rate TQM effectiveness and usefulness similarly.
Here 20 of the 38 respondents did not rate TQM and Continuous Improvement as of similar usefulness.

In this case 18 respondents rated Usefulness of TQM and Concentrate on the Process as of significantly different value.

**Understanding and Application**

In this section, the rating given by the IR&D managers to understanding of quality principles by the scientists is compared with that given for application, and the ratings given to senior management for understanding and application is compared with those given to scientists.

A negative value means that application exceeds understanding, or that scientists' understanding or application exceeds that of management. One would “expect” that management’s grasp of quality to be seen as better than their subordinates.

There are grounds for concern if in research scientist’s use of quality principles, their application exceeds their understanding.
This was the case for 5 of the respondents, who assessed scientist’s application as greater than their application. (negative values in the charts above and below)

The same concern exists for senior management

In only two cases was Understanding seen as lower than Application.

The understanding of quality principles should been seen as greater in senior management than in scientists.

But it isn’t in 9 cases.

Similarly the application of quality principles should be greater by senior management if they are to lead effectively.

But it is not in 9 cases.
In “Implementing Total Quality in R&D”, Wood and McCarney (Wood 1993) identify six parts to their model. Of these the first is “Leadership by Management”. Of the five sub-areas in which leadership by management is critical, the first is “.. a visible, vocal advocate, but also a role model”. It is hard to see how this can be achieved when management’s grasp of quality principles is seen as inadequate.

The above analysis shows that it was common for answers within a single questionnaire response to be inconsistent. When …

- TQM rated highly
  but
- Continuous Improvement rated low

- Application of quality principles were rated higher
  than
- Understanding of quality principles
  Particularly concerning when this was the assessment for senior management!

- Understanding and application of quality was sometimes seen as higher amongst scientists than senior management

- A program listed as low in usefulness
  but
- high in effectiveness

- There were also cases where
  A program listed as very useful
  but
- not listed as having been done!

From discussions with industrial research managers on quality issues and applications in an R&D laboratory it was common that outside quality consultants were used. In many cases ISO certification was pursued as this was seen as a mechanical way of achieving “quality”. As such it could be delegated to a subordinate, often an energetic junior. (These discussions were held largely in the year that the AIRG had “Quality” as their theme for the year. It was the same year that one of the authors was president of that organisation.) These approaches, of using consultants and of delegating, usually proved ineffective as management did not develop the understanding that comes from a high level of involvement.

6 Conclusions

The questionnaire was directed to industrial research managers, so the light it shed was on their understanding of quality principles and their assessment of the understanding of quality principles of those above and below them in their organisation.

From their responses it may be deduced that the understanding of quality was low, except in a very few cases. With the number of members of the Australian Industrial Research group falling steadily (a very good indicator of the state of industrial research in Australia) due to cut-backs in R&D by many firms, it is understandable that many R&D managers are in survival mode. The concern with output rather than process is understandable given the importance placed on “results” in industry. (There is a parallel here with the experience of manufacturing industry. When undue emphasis is placed on the output and inadequate attention is paid to quality through concentration on the process, then the ability to produce goods cheaply and easily suffers.)

This has implications for the long-term success of initiatives, such as the Innovation Summit sponsored by the Federal Government. It takes effort and time to gain the benefits which can flow from a quality initiative, but if the importance of this is not appreciated then there is a risk of seeking to develop
uncompetitive industries. (What happened to US color television manufacturing should be a warning to us.)

The impact is compounded when senior management is assessed as having limited understanding of quality.

The responses did not reveal an appreciation that there was a need to change the thinking of the workforce, or that this would take time. Lip service was paid to the need to increase quality understanding and application, but there was usually no current program to do this and, they were not interested expending the effort needed to improve their quality understanding and application. The willingness to rate application higher than understanding was a concern. No respondent identified this as a problem. The evidence suggests that some incentive is needed by Australian industrial research and development for them to understand and improve quality and so become world competitive. The big challenge is to generate a desire to develop quality understanding and its application in industrial R&D. Without this understanding it is hard to see how we can develop competitive industries as a result of the Innovation Summit.

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