

Quality Management in Industrial Research and Development -A Preliminary Comparison of International Understandings

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ABSTRACT

The understanding of quality concepts of industrial research managers, in Australia and in Brazil, has been assessed by evaluation of their responses to a questionnaire on quality.

The levels of understanding of the industrial research managers from the two countries are compared and conclusions for the implementation of innovation initiatives in the two countries are made.

Also the industrial research managers' perception of quality understanding at a number of levels in their organisations is evaluated. The results are illuminating.

It is concluded that limited appreciation of quality issues and mis-understandings of quality that persist in the industrial communities can impact the current push for increased innovation levels.

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

1 Introduction

With the increased emphasis in Australia on innovation in recent years, the understanding of basic quality concepts by industrial research managers was evaluated, as they must carry a pivotal role in any increased innovation initiatives in Australia. The results were a concern to those who see quality understanding as critical for effective implementation and application of R&D in the industrial world. (Harvey 1999, Harvey 2000)

It is hard to see how innovation initiatives can result in internationally competitive industries if those who will implement the initiatives do not have a good grasp of quality fundamentals, unless quality knowledge is similarly lacking in other countries.

The Business Council of Australia (BCA) and the Federal Government sponsored an Innovation Summit in February 2000 in Melbourne. Its aim was to improve the performance of Australia in the field of innovation, as a high level of innovation was regarded as essential for sound economic growth. There are several accounts by participants of plans for the Summit, the environment in which it was to be held and its follow-up. (Donaghue 1999, Buckingham 1999, BCA 1999a).

The report of the Implementation Group has been released (ISIG 2000), but whatever the final outcome of the Summit is, the industrial R&D sector will be critical to any successful implementation impacting directly on the wealth producing segment of Australian society.

A report dealing with much the same area, issued at about the same time, was the Chief Scientist's "Science Capability Review". It is entitled "The Chance to Change ... Discussion Paper by the Chief Scientist". (Batterham 2000)

A response (AIRG 2000) to both these reports has been prepared by the Australian Industrial Research Group. Membership of the AIRG comprises heads (or retired heads) of industrial research laboratories in Australia. Collectively they manage the majority of industrial research in Australia. The members welcomed many of the initiatives proposed in these reports. However the overwhelming view was that even if all the recommendations were accepted and implemented by the Federal Government, they would have little impact in reversing the decline in BERD (Business Expenditure on Research and Development) which has occurred in Australia since 1996.

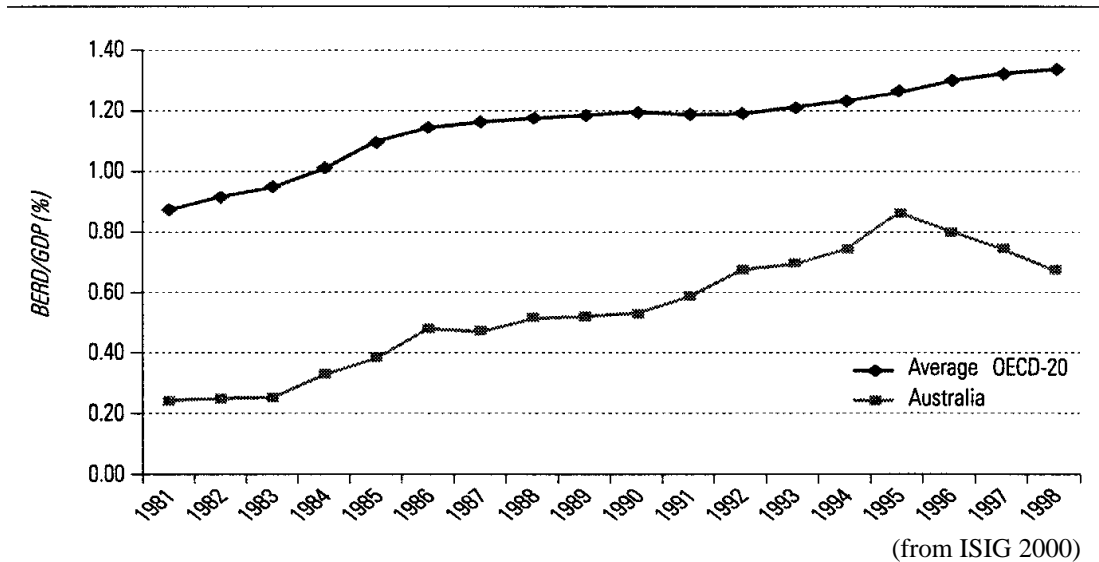
To enable monitoring of the understanding of basic quality concepts by industrial research managers in other countries, a study has begun to evaluate the "quality understanding" of industrial research managers internationally. Thus far a limited number of replies have been received from Brazil. These have been analysed using the same

techniques as used for the Australian data and the results compared with those from Australia.

2 R&D Trends

It is now well accepted that industrial R&D in Australia has been in serious decline since 1996.

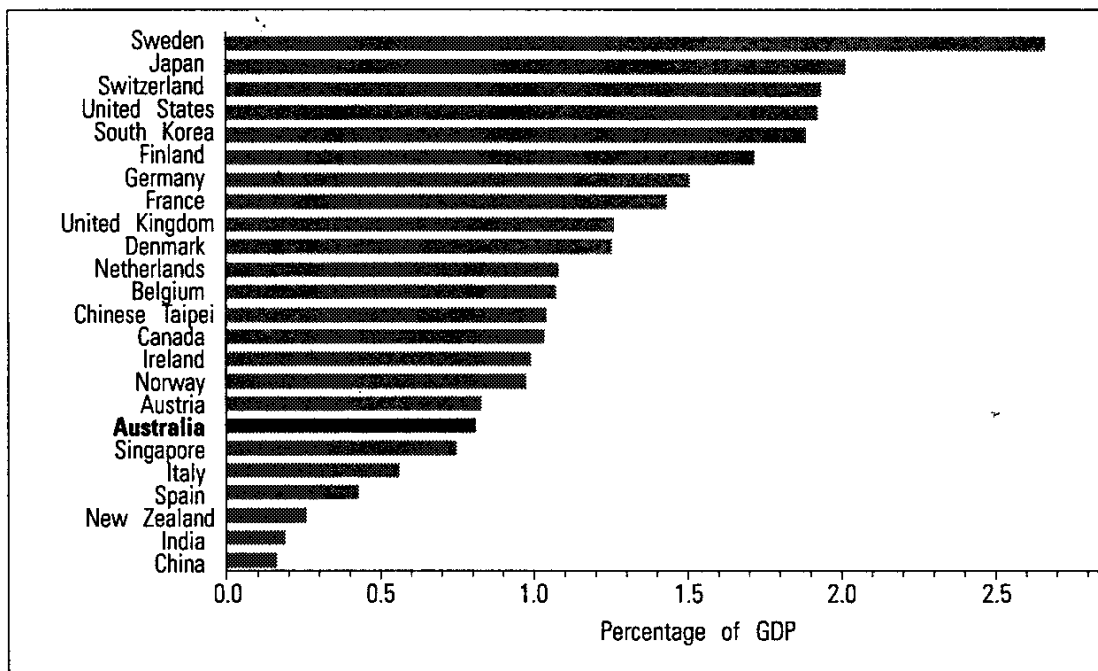
Business Expenditure on R&D as a percentage of GDP



In a study by the Business Council of Australia, BCA (1999b) BRW (1998), attention was drawn to the fall in R&D expenditure by business 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. (This expectation has been borne out by anecdotal information, such as the sharp decline in membership of the Australian Industrial Research Group.)

Such a reduction is a serious concern, especially as Australia has not been performing well compared with the performance of other OECD countries. This is dramatically illustrated by the above and the following figures.

Business Expenditure on R&D as a percentage of GDP – International Comparisons



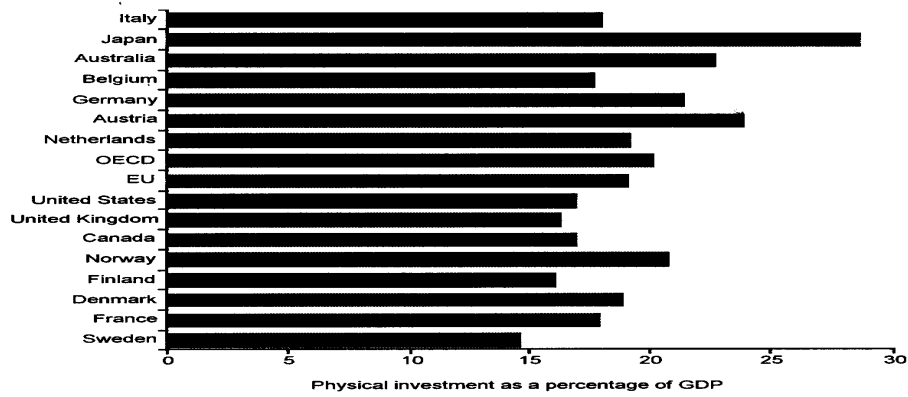
from (ISIG 2000)

These figures show that Australia is performing badly compared with comparable countries, so further slippage ought to be avoided.

It is not valid to attribute the decline after 1996 simply to the removal of “syndication” from the tax concession scheme. (Syndication was designed to make available venture capital for R&D in the private sector, but it was removed due to concerns over tax evasion.) This cut back in industrial research, both in the number of laboratories and the number of staff in those laboratories, effectively reduces Australia’s investment in the future. This is evidenced by an Industry Commission Report (IC1995) which found that the return to the whole economy of R&D can be very high.

In most other comparable countries the level of IR&D performed is substantially better. The overall picture is shown in Australia's Chief Scientist's review of the science capability. (Batterham 2000).

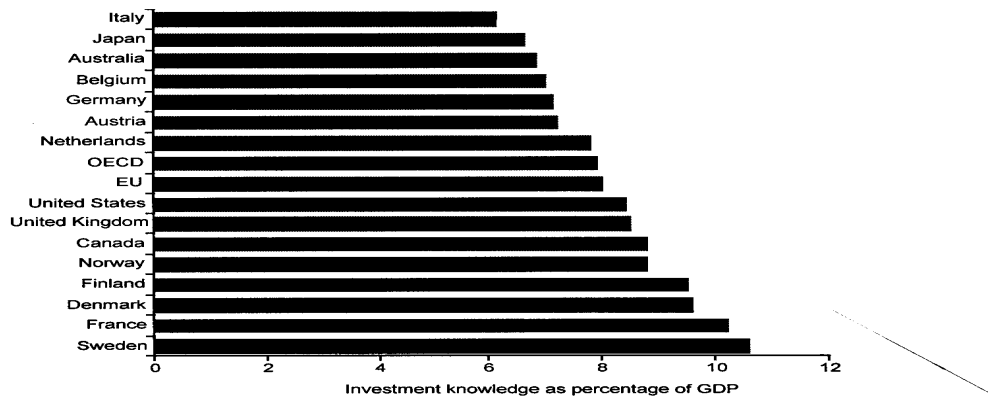
Physical investment as a percentage of GDP, 1995



(from Batterham 2000)

Whilst Australia's investment in capital equipment is good by world standards, Australia's investment in knowledge (e.g. R&D, software, education) is poor.

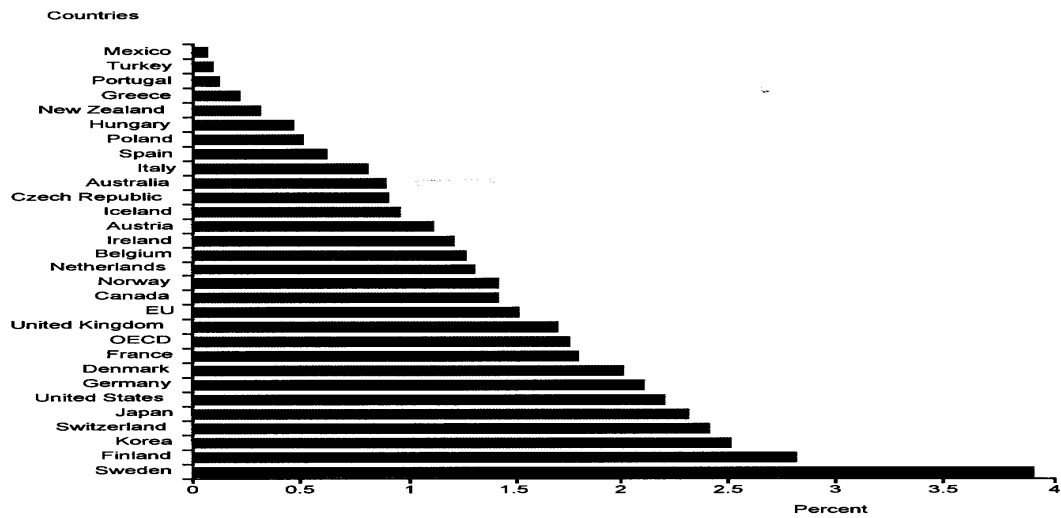
Investment in knowledge as a percentage of GDP, 1995



(from Batterham 2000)

Business R&D Intensity (R&D/Sales) shows a firm's investment in innovation. In this Australia also fares poorly.

Intensity of business R&D in domestic product of industry, 1997 or latest available year.



(from Batterham 2000)

All this is occurring while some competitors are investing heavily in R&D. In particular, the USA is experiencing a boom in industrial research. (Larson 2000)

Whilst overall R&D investment by industry in the USA grew by 71% between 1994 and 1999, it was skewed toward the research end. This is shown by a breakup of the R&D investment by industry during this period, which is as follows:

Development	65%
Applied research	91%
Directed basic research	79%
Industry support of University research	49%

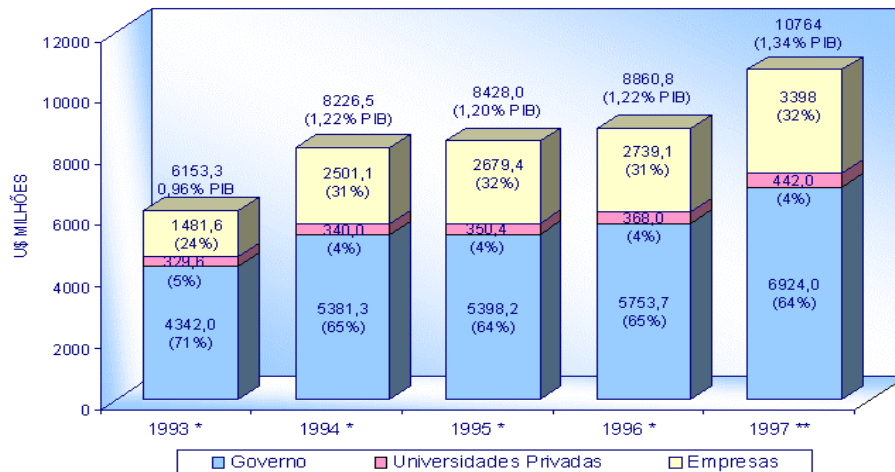
Brazilian Situation

Of particular significance to this study is the situation in Brazil.

Until very recent years the investment by business was steady at 31% to 32% of national spending on science and technology in an environment when R&D spending was growing, as illustrated by the following chart.

National Expenditure on Science and Technology (DCNT) in Brazil

DISPÊNDIOS NACIONAIS EM CIÊNCIA E TECNOLOGIA (DNCT) NO BRASIL



(*) Dados Oficiais MCT/CNPq, em US\$ milhões de 1995

(**) Dados não oficiais MCT/CNPq, em US\$ milhões de 1997

4 Understanding of Quality in IR&D

A survey is being conducted with the participation of members ANPEI (Brazil) which parallels the survey already conducted with members of the Australian Industrial Research Group (AIRG).

The questionnaire issued explored many of the attitudes to quality of industrial R&D managers and their perceptions of the attitude to quality of selected other groups in their companies. This paper concentrates on the levels of understanding, and misunderstanding, that were apparent from responses to the questionnaire.

(The driving force for this study came from events in 1993. In that year one of the authors was president of the AIRG and established 'Quality in R& D' as the theme for its year's meetings. (AIRG 1993). In that years' sessions it became clear that few of the industrial research managers had a sound working knowledge of basic quality principles. Such information is anecdotal by nature, so a survey was designed to place this knowledge on a more quantifiable basis.

As a result of globalisation the understanding of quality amongst R&D managers in other countries is highly relevant to the future prosperity of Australia. Brazil was considered

first as ANPEI was keen to be involved and learn from the study. It is a valid country to compare with Australia if we are considering trade, as can be seen from the table below.

	Australia	Brazil
Area - land	7,617,930 sq km	8,456,510 sq km
Population:	19,169,083 (July 2000 est.)	172,860,370 (July 2000 est.)
Literacy: (<i>definition: age 15 and over can read and write</i>)	100%	83.3%
Economy - overview:	Australia has a prosperous Western-style capitalist economy, with a per capita GDP at the level of the four dominant West European economies.	Possessing large and well-developed agricultural, mining, manufacturing, and service sectors, Brazil's economy outweighs that of all other South American countries and is expanding its presence in world markets
GDP -	\$416.2 billion (1999 est.)	\$1.057 trillion (1999 est.)
GDP - per capita:	\$22,200 (1999 est.)	\$6,150 (1999 est.)
GDP - from industry	26%	36%
Exports	\$58 billion (f.o.b., 1999 est.)	\$46.9 billion (f.o.b., 1999)
Imports:	\$67 billion (f.o.b., 1999 est.)	\$48.7 billion (f.o.b., 1999)
Debt - external:	\$222 billion (1999)	\$200 billion (1999)

The contractionary environment for industrial research and development in Australia at the time this survey was conducted has continued. However as noted before the IR&D contraction in Brazil is even more severe.

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 which has occurred in Australia is coupled with concomitant reductions in size of research groups, the capability of IR&D in Australia is in steep decline. A report of the results of this study into attitudes to quality amongst IR&D managers in Australia was presented at the Third International and Sixth National Research Conference on Quality Management in Melbourne in February 1999 [Harvey (1999)]. An analysis of the implications for innovation of misunderstandings of quality by amongst IR&D managers in Australia was presented at the Fourth International and Seventh National Research Conference on Quality Management in Sydney in February 2000 [Harvey (2000)]

5 Industrial Research Quality Study

Aims

This study was designed to investigate the:

- current status of quality in industrial R&D
- perceived knowledge of the participants.
- knowledge of others in their company as assessed by the respondents
- quality programs that have been used.
- perceived need to increase understanding of quality
- perceived need to increase application of quality

This paper focuses on the consistency of responses and the implications of understanding of quality principles on R&D innovation initiatives in Australia and Brazil.

Understanding of basic Quality principles by R&D Managers in Brazil and Australia

In assessing understanding of quality, consideration was given to

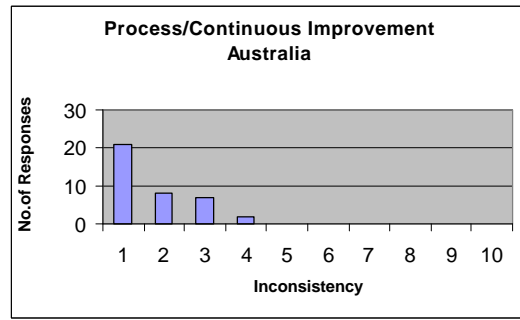
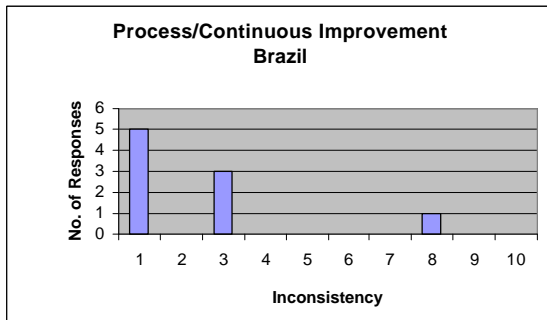
- priorities assigned to quality concepts,
- perceived understanding and application of quality at the scientist level
- perceived understanding and application of quality at the senior management level,
- usefulness and effectiveness of specific quality programs
- impact of quality programs on Research 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 the respondents have a sound basic quality understanding, as important quality concepts could all be rated as of low importance.

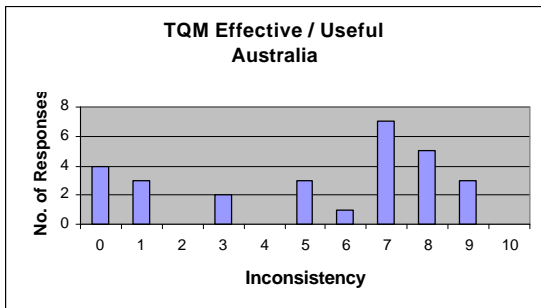
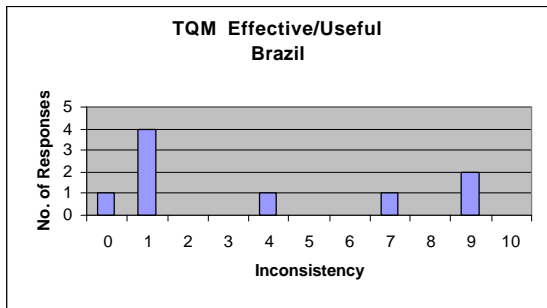
Response Inconsistency

In this analysis, the priorities assigned to basic quality concepts were compared. In cases of consistency (where matching concepts were assigned the same priority) the analysis returned a "0". Where concepts were rated in the one Priority List, of course the lowest difference was "1". A higher number shows an 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.

This analysis does not assess the “rightness” of a response, so similar concepts may both be given a low rating. (i.e. 0 or 1 – consistent, 2 and higher – increasing inconsistency)

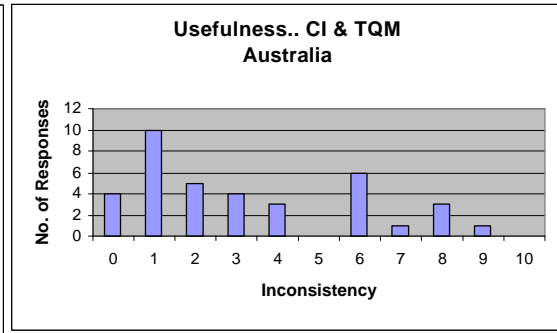
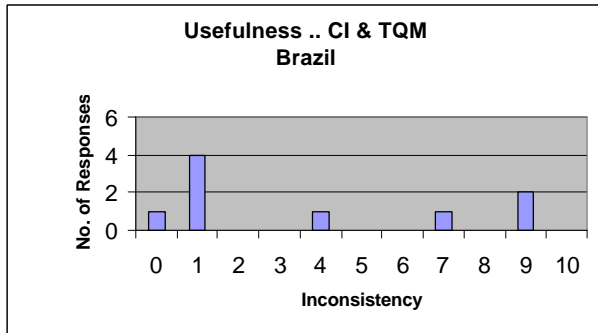


In both countries, just over half the respondents gave similar priority ratings to *CI* and *Process*, but a substantial minority did not. Hence the minority’s understanding must be questioned.

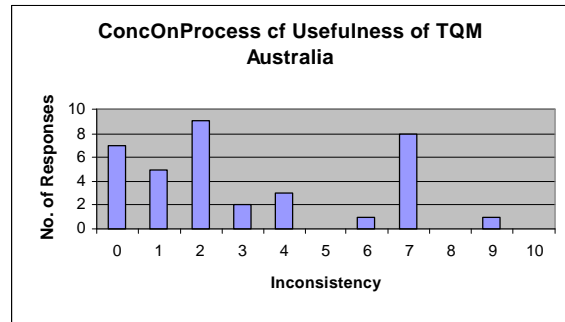
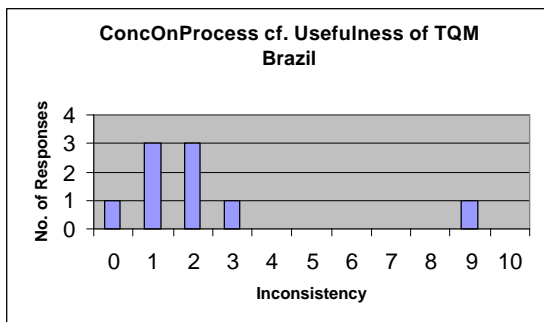


(Since the assessments were in differing questions, it was possible to give the same rating to *effectiveness* and *usefulness*, so an inconsistency rating of “0” was possible.)

The rating of effectiveness and usefulness of TQM caused concern. In both countries a substantial number of respondents gave very differing ratings to effectiveness and usefulness of TQM. This leads one to question their understanding of the process. It is possible that in such cases their responses mean “I think TQM is effective, but in my case I did not find it useful”.



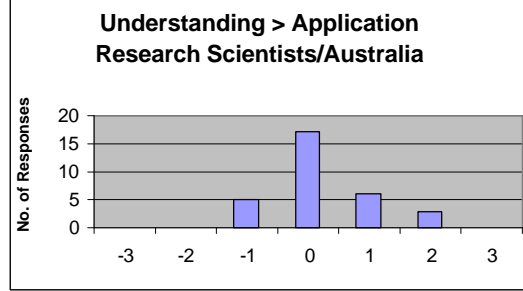
Since the concept of Continuous Improvement is embedded in TQM, a differing rating for usefulness of these two approaches shows a lack of understanding. Here most respondents did not give the same rating to CI and TQM, although more had a similar rating for the two concepts considered than in the previous case.



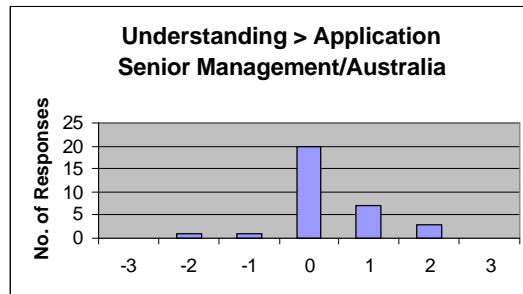
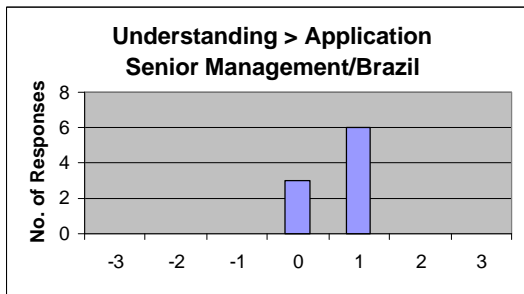
Similarly a concentration on the process is fundamental to TQM. Here more respondents seem to appreciate the linkage between these concepts, but many do not.

The questionnaire also probed the perception of *understanding* and *application* of quality by scientists and senior management.

It is a cause for concern if *understanding* was not seen as at least equal to *application*, as quality approaches can get a very bad name if quality initiatives are poorly implemented and hence fail. This can most effectively stop any further development in the quality area.

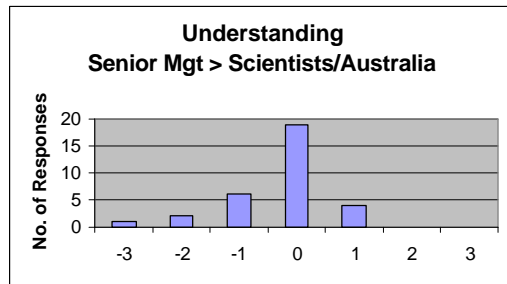
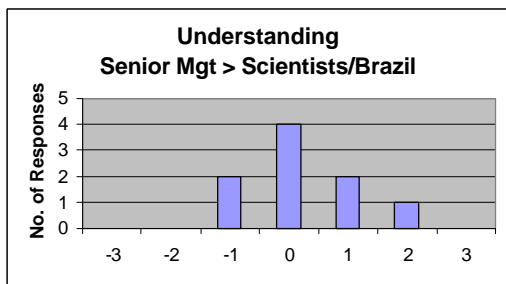


In both countries understanding of scientists was seen as exceeding their application except in a few cases in Australia.

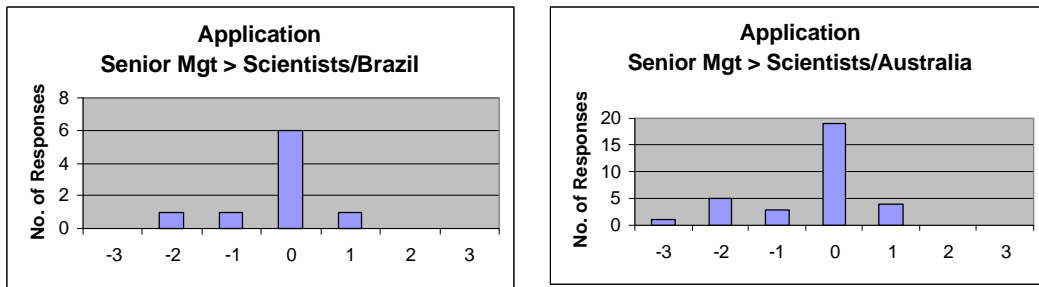


The same applies for senior management, except in rare cases in Australia, very few were seen as trying to apply quality with inadequate understanding.

Also if the understanding or application of quality by senior management was seen as inferior to that of the scientists, quality initiatives by senior management may be not well regarded by scientists with a greater understanding of quality. If this occurs, the chances of successful attempts at quality initiatives are greatly reduced.



Here we see a disturbing profile. Some members of senior management are perceived as having a lesser understanding than the scientists under them have.



The picture is even more pronounced in the application area. There are a scatter of senior management, in both countries, who are not seen as being as competent as the scientists under them when applying quality in their company.

6. Conclusion

Although the data available thus far is preliminary, it seems that the understanding and application of basic quality concepts by industrial research and development managers in Brazil is similar to that of their Australian counterparts. If that is so we need not fear that better implementation of innovation initiatives, due to a better grasp of quality fundamentals, by industry in Brazil will lead to Australian exports being uncompetitive with those from Brazil. Although that country is not considered one of Australia's major competitors, it provides a "straw in the wind" of attitudes elsewhere internationally.

The next phase of this work will be to the USA and then Europe. USA and Europe are potentially much more formidable competitors and so will provide a real test, especially in the USA, as industrial R&D in that country is currently in a boom.

7. Acknowledgment

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