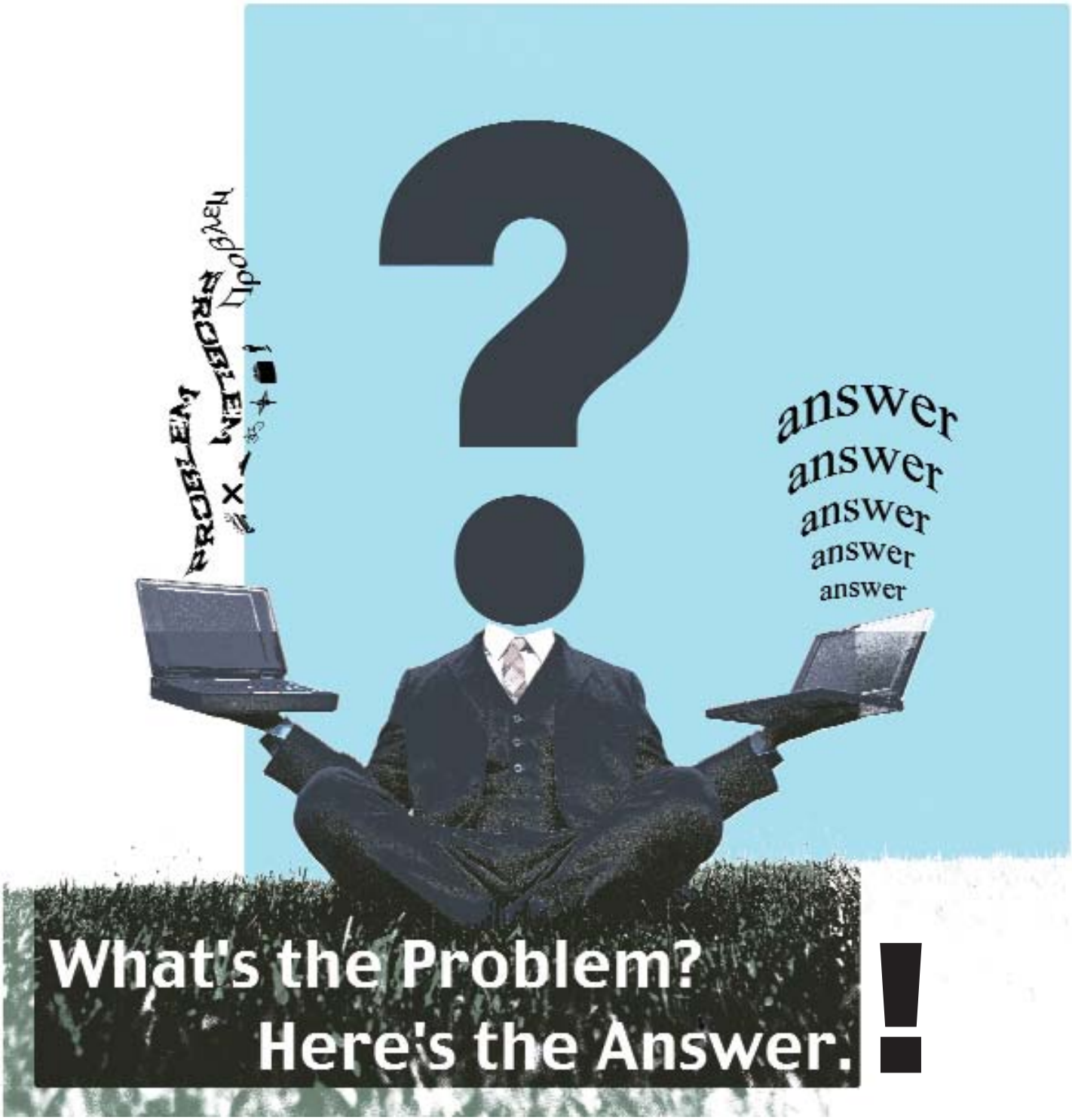

Mary-Ann MacInnes and Mark Mutter, Cement Performance International, UK, discuss the benefits of root cause analysis in the cement industry.

Introduction

Root cause analysis (RCA) is a well established tool used across many industries, mainly in the domain of equipment reliability. Increasingly, however, the trend has been to spread the uses of this analysis tool to produce solutions in areas such as accident analysis, environmental non-compliance, quality incidents and loss of output. Whilst the principles of RCA are relatively simple - identify the problem to be solved, the real causes of that problem and then provide effective solutions to the problem - there are a number of variants as to how the process is actually conducted. Cement Performance International (cpi) has recently been working with a number of clients with its tailored RCA programme, which encourages well-managed group participation,

an involvement of the team members once the solutions have been defined and a monitoring programme which ensures that the actions of the analysis are implemented. Such an approach is particularly important to ensure that the relevant facts are brought out in the analysis, that the session is effective without becoming time consuming and that the process has credibility by the implementation of their solutions (one of the biggest failings of RCA programmes is the lack of visible results once recommendations have been agreed).

RCA methodology

The company introduces its clients to RCA through training courses. The aim is to focus on the background and objectives of RCA, to introduce RCA as a continuous improvement tool, and to give the participants an opportunity to use the methodology with the trainer. The trainer uses no pre-prepared examples but takes problems and data from the plant as part of the training. In this way RCA is made relevant to the plant and demonstrates RCA can be effective on real problems. Working through plant problems also gives the trainer the opportunity to observe the group dynamics and the participant's data collection and analysis skills. Where appropriate, team-working or analysis skills can be incorporated into the training, resulting in the plant personnel being effective in all areas of RCA, not just the methodology. The initial team that are trained will then become the core team of RCA workshop leaders and workshop facilitators.

The selection of the group members to analyse an incident does require some thought. It is important that as many of the team members as possible have been trained in the RCA methodology so that they understand the "rules of the game" and that the aim is to find effective solutions to the stated problem. Those who have not been trained should be briefed at the start of the session as to how RCA works and coached throughout the session. An ideal mix would be a group of six to eight people, with a multi-disciplinary background, and from different levels of the plant hierarchy - management, supervisory and plant operative. It is key to have at least one member in the group who was present at the time of the incident so that there can be no ambiguity in the facts of the incident. If this is not the case the group may well produce a set of causes which are totally unrelated to the incident because they have worked from a set of suppositions.

Once an incident has been identified as an RCA subject, all the facts relevant to the sequence of events leading up to, during and after the incident being investigated should be collected. It is essential that the correct information is collected at the time of the incident - this information must be factual and not the opinions and judgements of those involved. A simple report should be written within 24 hours of the incident occurring and, if appropriate, photographic and any other evidence should also be collected; this will be used at a later stage to help those in the RCA group visualise the circumstances of the incident. This evidence could be process samples, control room readings or graphs, types of personal protective equipment used, etc. Furthermore the RCA investigation must be completed relatively quickly after the event has occurred so that those involved still have the information fresh in their minds. An RCA team leader should be appointed; the team leader must be trained in RCA tools and must be a good facilitator to keep the process on track and keep the session moving. Ideally he/she should have some decision making influence within the organisation, such that realistic and achievable actions are agreed on by the group. A date for the meeting of the group should be set by the appointed team leader for the session and all members of the group should be reminded of the need to prepare for the meeting - bring any pertinent information, read the incident report, etc.

A site visit by the RCA team to the incident area can prove valuable as some team members may be called upon due to their knowledge or experience, but may not be familiar with a particular area of the plant. At times this is not possible, for example, if the team is investigating kiln build-up incidents where access to the kiln is not possible. In this case photographic evidence or even data from the process or samples take on more significance in allowing the team to visualise the problem to be solved.

Once the RCA group has met, the first task, before the events of the incident are discussed, is to establish the problem to be solved. This is a pre-requisite of the success of the group as all members must be in agreement as to their purpose. It also qualifies exactly the final outcome for which solutions are sought. The problem statement should be short, precise and clear - for example "twisted left ankle" or "kiln dust emissions above limit".

This problem statement is then further defined by the questioning words of who, when, and where. The significance of the incident is also important to establish - who is affected by the incident and what the impact is. In the case of an accident this could be the individual or individuals concerned and any short or long term consequences for the company. For a quality incident it could be the short-term production impact upon the customers and the longer term effect on relationships and sales volumes. A production incident may lead to a stock-out of product with the financial loss due to missed sales opportunities. Stating the significance should focus those involved on the potential gain by solving the stated problem.

The method is flexible with regard to the actual tool that is used within the group to bring out the cause and effects relating to the incident. In some cases and cultures a cause and effect tree can be constructed using note paper to allow the correct order of the facts to be established by the team. In this way the team works backwards from the initial problem (using the questions word "why" or the

statement "caused by") identifying the causes until it feels it can go no further, i.e. the root causes have been identified. In other cases it is more productive to use a fishbone diagram, putting up all the potential causes first and then later discussing within the group which are the real factors relating to the incident . When using the fishbone any type of category can be added and the group should not restrict themselves to the traditional headings of manpower, machinery, money, methods and materials. This allows totally free thought as participants do not feel restrained to thinking in certain categories. In both methods this part of the exercise is a "brain-dump" for the team members and allows as much information as possible to be collected. The fact that some causes are not relevant and are not used in the analysis is not important; what is important is that the right causes are brought out during this part of the analysis.

During the analysis any information that is not known or not available at the time is noted in an investigative action log for the information to be gathered and analysed. If it becomes clear that there is a large amount of investigation actions, the meeting can be stopped and a review date set to be able to discuss the incident with all of the relevant facts. The review date can be within the next few hours or in the next few days depending on the type of information required and, of course, on the urgency of the outcome of the investigation. The next review date should not be the date the last investigative action is to be completed by, but within the next few days.

One of the differences of the company's method is how the potential solutions are treated and implemented. Traditional methods focus on the cause and effects with the aim of finding one or two solutions to eliminate the problem identified. The cpi method aims to find solutions on a tiered basis such that the problem is either monitored, controlled, reduced or eliminated. By classifying actions in this way the company methodology allows both short and long term actions to be implemented, and a highly visible continuous improvement approach to be taken. The types of actions relating to the criteria are as follows:

- Monitoring - allowing the group members to follow certain parameters where more data is required for follow-up meetings.
- Controlling - the group define procedures to follow if a certain set of circumstances occur, again with the possibility of taking the outcomes back to the follow-up meeting for validation or modification.
- Reducing - implementation of fixed procedures which will reduce the impact of the problem in the short to medium term.
- Eliminating - actions which will take longer to implement or require capital investment or modifications to the structure.

The final task of the group is to agree actions, timescales and responsibility. As previously explained one of the biggest failings of RCA programmes is the lack of visible results from the effort put into the analysis phase by the team. The action plan is agreed by the group and realistic timescales attached to the specific actions. It is the responsibility of the individual to ensure that the action is completed and therefore all actions should be within the scope of the role of the individual. They must come to the review meeting with feedback on the outcome of the action (or even invite a colleague who has completed the action to talk to the team). The action plan is reviewed on a weekly basis to ensure that progress is being made and, when this is not the case, to identify what is needed to ensure that the actions do move forward.

Achievements

The company's RCA method has been implemented on a number of its clients' sites, resulting in continuous improvements in technical, quality and production issues, as well as being used for the more traditional kiln stoppage analysis. Some examples of these include:

- Slurry moisture reduction by implementing monitoring and controlling actions from the RCA studies, resulting in kiln fuel savings.
- Elimination of kiln build-up and ring formation resulting in additional annual run time and therefore additional kiln output, and avoidance of start-up costs.
- Reduction in the number of cement test result discrepancies between laboratory shift teams, resulting in greater confidence in results and improved quality monitoring.

Whilst these tangible results may have been achieved with any type of well organised and implemented RCA programme, the company has observed a number of other immeasurable gains through its programme, such as:

- An increase in personnel knowledge of the process and its problems, which then enables personnel to make informed decisions regarding the problems they encounter.
- A raised awareness of re-occurring problems at the management level - a large amount of re-occurring problems are small and are often lost when a 'fire fighting' approach is taken and problems are not analysed effectively.
- New and often improved methods of working.

Conclusion

The company have taken a fresh look at RCA with the aim of building upon a well established methodology. The cpi methodology allows the group sessions to be well managed, the group members to be part of the implementation of the solutions, promotes a continuous improvement mentality by allowing both short and long term actions to be part of the solution, and ensures that the actions are put in place through a rigorous monitoring programme.