

Australian/New Zealand Standard™

**Root cause analysis (RCA)**



## **AS/NZS IEC 62740:2016**

This Joint Australian/New Zealand Standard was prepared by Joint Technical Committee QR-005, Dependability. It was approved on behalf of the Council of Standards Australia on 21 July 2016 and by the New Zealand Standards Approval Board on 6 July 2016.

This Standard was published on 10 August 2016.

---

The following are represented on Committee QR-005:

Asset Management Council  
Department of Defence (Australian Government)  
Engineers Australia  
Independent Transport Safety and Reliability Regulator  
Institution of Professional Engineers New Zealand  
New Zealand Institute of Safety Management  
Risk Management Institution of Australasia  
University of New South Wales  
University of Wollongong

---

### **Keeping Standards up-to-date**

Standards are living documents which reflect progress in science, technology and systems. To maintain their currency, all Standards are periodically reviewed, and new editions are published. Between editions, amendments may be issued. Standards may also be withdrawn. It is important that readers assure themselves they are using a current Standard, which should include any amendments which may have been published since the Standard was purchased.

Detailed information about joint Australian/New Zealand Standards can be found by visiting the Standards Web Shop at [www.saiglobal.com](http://www.saiglobal.com) or Standards New Zealand web site at [www.standards.govt.nz](http://www.standards.govt.nz) and looking up the relevant Standard in the on-line catalogue.

For more frequent listings or notification of revisions, amendments and withdrawals, Standards Australia and Standards New Zealand offer a number of update services. For information about these services, users should contact their respective national Standards organization.

We also welcome suggestions for improvement in our Standards, and especially encourage readers to notify us immediately of any apparent inaccuracies or ambiguities. Please address your comments to the Chief Executive of Standards Australia or the New Zealand Standards Executive at the address shown on the back cover.

---

Australian/New Zealand Standard™

**Root cause analysis (RCA)**

First published as AS/NZS IEC 62740:2016.

**COPYRIGHT**

© Standards Australia Limited/Standards New Zealand

All rights are reserved. No part of this work may be reproduced or copied in any form or by any means, electronic or mechanical, including photocopying, without the written permission of the publisher, unless otherwise permitted under the Copyright Act 1968 (Australia) or the Copyright Act 1994 (New Zealand).

Jointly published by SAI Global Limited under licence from Standards Australia Limited, GPO Box 476, Sydney, NSW 2001 and by Standards New Zealand, PO Box 10729, Wellington 6011.

ISBN 978 1 76035 555 5

## PREFACE

This Standard was prepared by the Joint Standards Australia/Standards New Zealand Committee QR-005, Dependability.

The objective of this Standard is to specify the steps that root cause analysis (RCA) should include and explain some techniques for identifying root causes. The Standard identifies a number of attributes of RCA techniques which assist with the selection of an appropriate technique. It describes each RCA technique and its relative strengths and weaknesses.

This Standard is identical with, and has been reproduced from IEC 62740:2015, *Root cause analysis (RCA)*.

As this Standard is reproduced from an International Standard, the following applies:

- (a) In the source text 'this International Standard' should read 'Australian/New Zealand Standard'.
- (b) A full point substitutes for a comma when referring to a decimal marker.

The term 'informative' has been used in this Standard to define the application of the annexes to which it applies. An 'informative' annex is only for information and guidance.

## CONTENTS

1	Scope .....	9
2	Normative references .....	9
3	Terms, definitions and abbreviations .....	9
3.1	Terms and definitions.....	9
3.2	Abbreviations .....	12
4	RCA – Overview .....	12
5	The RCA process .....	13
5.1	Overview.....	13
5.2	Initiation.....	14
5.3	Establishing facts.....	15
5.4	Analysis .....	17
5.4.1	Description .....	17
5.4.2	The analysis team .....	18
5.5	Validation.....	19
5.6	Presentation of results .....	19
6	Selection of techniques for analysing causes.....	20
6.1	General.....	20
6.2	Selection of analysis techniques .....	20
6.3	Useful tools to assist RCA.....	21
Annex A	(informative) Summary and criteria of commonly used RCA techniques .....	22
A.1	General.....	22
A.2	RCA techniques .....	22
A.3	Criteria.....	23
Annex B	(informative) RCA models .....	26
B.1	General.....	26
B.2	Barrier analysis.....	26
B.2.1	Overview .....	26
B.2.2	Strengths and limitations .....	27
B.3	Reason's model (Swiss cheese model) .....	27
B.3.1	Overview .....	27
B.3.2	Strength and limitations .....	28
B.4	Systems models.....	28
B.5	Systemic theoretic accident model and processes (STAMP) .....	29
B.5.1	Overview .....	29
B.5.2	Strengths and limitations .....	29
Annex C	(informative) Detailed description of RCA techniques .....	30
C.1	General.....	30
C.2	Events and causal factors (ECF) charting .....	30
C.2.1	Overview .....	30
C.2.2	Process .....	31
C.2.3	Strengths and limitations .....	31
C.3	Multilinear events sequencing (MES) and sequentially timed events plotting (STEP).....	32

C.3.1	Overview .....	32
C.3.2	Process .....	32
C.3.3	Strengths and limitations .....	33
C.4	The 'why' method.....	35
C.4.1	Overview .....	35
C.4.2	Process .....	36
C.4.3	Strengths and limitations .....	36
C.5	Causes tree method (CTM) .....	36
C.5.1	Overview .....	36
C.5.2	Process .....	39
C.5.3	Strengths and limitations .....	39
C.6	Why-because analysis (WBA) .....	39
C.6.1	Overview .....	39
C.6.2	Process .....	42
C.6.3	Strengths and limitations .....	42
C.7	Fault tree and success tree method .....	42
C.7.1	Overview .....	42
C.7.2	Process .....	43
C.7.3	Strengths and limitations .....	44
C.8	Fishbone or Ishikawa diagram.....	44
C.8.1	Overview .....	44
C.8.2	Process .....	45
C.8.3	Strengths and limitations .....	46
C.9	Safety through organizational learning (STOL) .....	46
C.9.1	Overview .....	46
C.9.2	Process .....	46
C.9.3	Strengths and limitations .....	47
C.10	Management oversight and task error (MORT) .....	48
C.10.1	Overview .....	48
C.10.2	Process .....	48
C.10.3	Strengths and limitations .....	48
C.11	AcciMaps .....	49
C.11.1	Overview .....	49
C.11.2	Process .....	49
C.11.3	Strengths and limitations .....	51
C.12	Trinco Beta .....	51
C.12.1	Overview .....	51
C.12.2	Process .....	52
C.12.3	Strengths and limitations .....	52
C.13	Causal analysis using STAMP (CAST) .....	53
C.13.1	Overview .....	53
C.13.2	Process .....	56
C.13.3	Strengths and limitations .....	57
Annex D (informative)	Useful tools to assist root cause analysis (RCA) .....	58
D.1	General.....	58
D.2	Data mining and clustering techniques .....	58
D.2.1	Overview .....	58
D.2.2	Example 1 .....	58
D.2.3	Example 2 .....	58

D.2.4	Example 3 .....	59
Annex E (informative)	Analysis of human performance .....	60
E.1	General.....	60
E.2	Analysis of human failure .....	60
E.3	Technique for retrospective and predictive analysis of cognitive errors (TRACER).....	61
E.3.1	Overview .....	61
E.3.2	Process .....	62
E.4	Human factors analysis and classification scheme (HFACS) .....	63
E.4.1	Overview .....	63
E.4.2	Process .....	63
Bibliography	.....	66
Figure 1	– RCA process .....	14
Figure B.1	– Broken, ineffective and missing barriers causing the focus event .....	26
Figure C.1	– Example of an ECF chart.....	31
Figure C.2	– Data in an event building block .....	32
Figure C.3	– Example of a time-actor matrix .....	34
Figure C.4	– Example of a why tree .....	35
Figure C.5	– Symbols and links used in CTM.....	37
Figure C.6	– Example of a cause tree .....	38
Figure C.7	– Example of a WBG .....	41
Figure C.8	– Example of a fault tree during the analysis .....	43
Figure C.9	– Example of a Fishbone diagram.....	45
Figure C.10	– Example of a MORT diagram .....	48
Figure C.11	– Example of an AcciMap .....	50
Figure C.12	– Example of a Tripod Bar chart diagram .....	52
Figure C.13	– Control structure for the water supply in a small town in Canada .....	55
Figure C.14	– Example CASP causal analysis for the local Department of health.....	56
Figure C.15	– Example CASP causal analysis for the local public utility operations management.....	56
Figure E.1	– Example of an TRACER model [25].....	61
Figure E.2	– Generation of internal error modes .....	62
Figure E.3	– Level 1: Unsafe acts .....	64
Figure E.4	– Level 2: Preconditions .....	64
Figure E.5	– Level 3: Supervision Issues .....	65
Figure E.6	– Level 4: Organizational Issues .....	65
Table 1	– Steps to RCA .....	13
Table A.1	– Brief description of RCA techniques .....	22
Table A.2	– Summary of RCA technique criteria.....	23
Table A.3	– Attributes of the generic RCA techniques .....	25
Table B.1	– Examples of barriers .....	27
Table B.2	– Example of the barrier analysis worksheet .....	27
Table C.1	– Direct and indirect causal factors .....	47

Table E.1 – External error modes.....	63
Table E.2 – Psychological error mechanisms.....	63

Currently in preview, click buy full version

## INTRODUCTION

Root cause analysis (RCA) refers to any systematic process that identifies factors that contributed to a particular event of interest (focus event). RCA is performed with the understanding that events are addressed by understanding the root causes, rather than the immediately obvious symptoms. RCA aims to reveal root causes so that either the likelihood of them occurring, or their impact if they do occur, can be changed.

An important distinction to make is that RCA is used to analyse a focus event that has occurred and therefore analyses the past (a posteriori). However, knowledge of the root causes of past events can lead to actions that generate improvements in the future.

This International Standard is intended to reflect current good practices in the conduct of RCA. This standard is general in nature, so that it may give guidance across many industries and situations. There may be industry specific standards in existence that establish preferred methodologies for particular applications. If these standards are in harmony with this publication, the industry standards will generally be sufficient.

This standard is a generic standard and does not explicitly address safety or accident investigation although the methods described in this standard may be used for this purpose.

NOTES

Currently in preview, click buy full version

## AUSTRALIAN/NEW ZEALAND STANDARD

## Root cause analysis (RCA)

### 1 Scope

This International Standard describes the basic principles of root cause analysis (RCA) and specifies the steps that a process for RCA should include.

This standard identifies a number of attributes for RCA techniques which assist with the selection of an appropriate technique. It describes each RCA technique and its relative strengths and weaknesses.

RCA is used to analyse the root causes of focus events with both positive and negative outcomes, but it is most commonly used for the analysis of failures and incidents. Causes for such events can be varied in nature, including design processes and techniques, organizational characteristics, human aspects and external events. RCA can be used for investigating the causes of non-conformances in quality (and other) management systems as well as for failure analysis, for example in maintenance or equipment testing.

RCA is used to analyse focus events that have occurred, therefore this standard only covers a posteriori analyses. It is recognized that some of the RCA techniques with adaptation can be used proactively in the design and development of items and for causal analysis during risk assessment; however, this standard focuses on the analysis of events which have occurred.

The intent of this standard is to describe a process for performing RCA and to explain the techniques for identifying root causes. These techniques are not designed to assign responsibility or liability, which is outside the scope of this standard.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary*

### 3 Terms, definitions and abbreviations

For the purposes of this document, the definitions given in IEC 60050-192, as well as the following, apply.

#### 3.1 Terms and definitions

##### 3.1.1

##### **cause**

circumstance or set of circumstances that leads to failure or success

Note 1 to entry: A cause may originate during specification, design, manufacture, installation, operation or maintenance.

[SOURCE: IEC 60050-192:2014, 192-03-11 modified – addition of the words “circumstance or” and “or success” in the term]