Defining Operational Readiness to Investigate

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Abstract

In 2005, the Noordwijk Risk Initiative Foundation and the UK's Royal Society for the Prevention of Accidents cooperated in a project to define operational readiness to investigate accidents and incidents (DORI). Based on previous work done by RoSPA, the partners believe that managers tend to over-estimate the readiness of their organisations to undertake investigations. Managers seem often not to appreciate the full range of competencies and capabilities needed to investigate adequately. The partners concern is that managerial optimism may compromise the ability of organisations to learn from their own accidents. The chaotic aftermath of an accident is at odds with the efficient performance of investigative tasks. Coping with the consequences of an accident, leaves little scope for devising from scratch, a well-scoped, methodologically sound, and adequately resourced investigation. Extreme circumstances demand a prepared investigative response. Even in less demanding situations, we contend that it is more efficient to be prepared.

In the light of the above, the DORI project partners decided that it would be helpful to raise managerial awareness of what is involved in investigation. Although some general principles apply, what constitutes an adequate investigation varies from situation to situation. In view of this diversity, it was decided that investigative competencies and capabilities should be discussed in a framework that emphasises the importance of context. To cater for these requirements, the project based its framework on the concept of operational readiness. This conceives readiness as a state in which procedures, equipment and people cohere in an organisational environment that has been designed to

promote good performance, even in the testing circumstances that sometimes prevail after an accident.

During the project, the present authors held discussions with managers of investigations in private and public sector organisations, including professional investigation bodies. These discussions aimed to inform a generic list of investigative tasks and to gain further insight into the issues involved in defining readiness. The result was a short "White Paper" describing the general process for defining readiness for the thirty-four generic tasks that comprise investigation.

Since the publication of the white paper, discussions with members of RoSPA's "Partners in Progress" scheme suggest that the issue of investigative readiness is seen by companies (rather than professional investigative bodies) as important and relevant, yet difficult to promote as a priority issue for top management. Amongst the reasons given for this paradox, is that readiness to investigate is rather too close to readiness to have accidents, at least connotatively. Having raised awareness, at least amongst a relatively captive population of managers, the hearts of chief executives have yet to won over.

Keywords: Operational Readiness, Accident Investigation.

1 Introduction

The Defining Operational Readiness to Investigate (DORI) project was a partnership between the Noordwijk Risk Initiative Foundation and the UK's Royal Society for the Prevention of Accidents. The two organisation's share the belief that accidents are often poorly investigated by employers, although the extent of this, and the reasons for it, are areas which need to be better researched. RoSPA's response to this belief is that of a campaigning organisation. NRI's response is similarly consistent with its aims: to encourage the sharing of knowledge by, amongst other means, providing tools to end users.

1.1 RoSPA's motivations

Since the mid-1990's, the UK Royal Society for the Prevention of Accidents has campaigned to raise the profile of accident investigation as a tool to improve safety through organisational learning. In 1998-1999, RoSPA undertook research into investigative approaches within companies verified to have high standards of health and safety management. Based on what it learned there and through other sources, RoSPA campaigned for a statutory duty to be placed on employers to investigate accidents. The Health and Safety Commission ultimately rejected this option. Subsequent guidance from the HSE (HSE, 2004) made it clear that such a responsibility is implicit in present legislation and that good investigation is a vital part of effective occupational health and safety management.

Through its auditing programme, RoSPA has for several years maintained a network of "high performing" organisations. This network has been a source of best practices for health and safety management. RoSPA believes that within higher performing organisations there is a wealth of good investigation practice that could be shared to help all other businesses to improve their approach to learning lessons from accidents and so prevent future injuries and fatalities.

As well as shaping the HSE guidance published in 2004, RoSPA argued successfully for a new annexe on investigation to be included in the revised version of British Standards Institute (BSI) guidance on H&S management systems (BS 8800). RoSPA has published a ten-point statement on good investigation backed by the Trades Union Congress, the Confederation of British Industry, the Association of British Insurers and the Institution of Occupational Safety and Health (IOSH, the British professional body for health and safety practitioners).

The ten point plan can be found at:
http://www.rospa.com/occupationalsafety/learning/tenpoints.htm.

1.1.1 RoSPA's perception of the problem

Whereas professional investigation bodies (such as the UK's Rail, Air and Marine Accident Investigation organisations and enforcement agencies like HSE) have investigation as a core operational activity, employers investigate accidents as an adjunct to their operations. Employer's investigations are shaped by a range of motives, some contradictory. On the one hand, there is the motive to prevent recurrence but, on the other, there is the desire to limit liability. However, even in organisations which place great weight on prevention of accidents, the quality of investigation often seems incongruently low. We do not believe this to be straightforwardly a product of the competence of investigators; we think that it reflects a broadly defined lack of organisational capability to investigate accidents.

We have hypothesised various reasons, for the persistence of this situation, three are considered here. First, when we have asked managers to estimate the difficulty of conducting a large accident investigation, the response is typically very confident; managers believe that their organisations will meet the challenge successfully. Second, when asked upon what grounds this belief is based, quite often the response indicates that the respondent does not have a clear understanding of the range of tasks and the situational demands that can be expected under such circumstances. Thirdly, further probing reveals that various of the basic arrangements are not in place and would have to be devised, resourced and implemented during the chaotic aftermath of an accident when the main priority of the organisation will be to restore business functions.

1.1.2 DORI as means to raise managerial awareness

RoSPA's interest in the DORI project is as a means to raise managerial awareness of what is involved in accident and incident investigation. Ultimately, RoSPA wants to see employers take a programmatic approach to their investigation activities and subject this

programme to the rigours of continuous improvement, as they would with key areas of performance.

1.2 NRI's Motivations

The Noordwijk Risk Initiative Foundation exists to encourage the sharing of knowledge about risk management. One of the ways the Foundation pursues this goal is to develop methods and put these into the public domain, free to end users.

To the secure the aims mentioned, NRI works in partnership with public and private sector organisations. For the most part, the Foundation relies on the professional networks of its board members to identify organisations that are interested in topics that NRI regards as a priority.

As well as innovating ideas and methods, some of NRI's priority topics concern revisiting ideas developed within the MORT safety assurance programme. This programme was run from 1969 to 1996, under various guises, by a number of contractor organisations to the US Department of Energy (and its predecessors). In the view of the NRI board members and others, there is still much currency and usefulness in the ideas and methods produced by that programme; NRI looks for opportunities to revise these. Hence, this year, the Foundation has worked with the Royal Dutch Navy to revise the MORT Users Manual and Chart (Frei et al., 2002); it is hoped that these materials will be available for download from the NRI web site (http://www.nri.eu.com) before the end of the year. The original report into the development of the MORT programme (Johnson, 1973) is already available for download.

1.2.1 Operational Readiness.

Less well-known than MORT analysis, but equally prominent in the thinking of Bill Johnson and his colleague Bob Nertney (the key figures of the MORT programme), was *operational readiness*. Nertney saw operational readiness as the expression of MORT ideas in a form that appealed to senior line managers. This is in contrast to MORT analysis that was designed with safety analysts in mind.

Nertney (1987) provides a definition of the concept, *"operational readiness means achieving a configuration which places the right people in the right places at the right times working with the right hardware according to the right procedures and management controls. At a secondary level, this implies that these elements are functioning in a proper physical and psychological environment"* (p.1).

The present authors saw the needs identified by RoSPA as a suitable opportunity to rehearse the ideas of operational readiness by applying them to the activities of accident investigation.

2 Project Description

Our intention was to develop a definition of 'readiness to investigate' that was sufficiently general to apply fairly universally; whether the organisation had investigation as a core duty (such as is true of enforcement agencies and professional investigation bodies) or as an ancillary duty (such as is true of employers).

In order to facilitate discussion with organisations who could inform DORI, we developed a green paper. This was published in September 2005.

2.1 The DORI Green Paper

We were aware that Johnson (1985) had developed extensive readiness "trees" (functional analyses, by another name) for accident investigation in the US Department of Energy. These trees were the basis from which to start the new work. The green paper consisted for the most part of tables derived from the hierarchical structure of these readiness trees. To these we added explanatory text.

In the Green paper, readiness was depicted as a programme consisting of nine developmental steps:

1. Develop willingness to investigate
2. Define requirements and criteria
   - *2.1. Codes, standards and regulations*
   - *2.2. Guidelines*
3. Specify planned incident response
   - *3.1. Emergency action*
   - *3.2. Preservation of evidence*
   - *3.3. Notification*
4. Develop investigation activation plan
   - *4.1. Identify potential participants*
   - *4.2. Identify potential stakeholders*
   - *4.3. Assemble investigative materials*
   - *4.4. Establish activation procedure*
5. Develop readiness to initiate investigation
   - *5.1. Ready to specify the investigation*
   - *5.2. Ready to consult stakeholders*
   - *5.3. Ready to appoint investigation team*
6. Develop readiness to manage investigation
   - *6.1. Ready to direct activities*
   - *6.2. Ready to coordinate activities*
   - *6.3. Ready to process evidence*
   - *6.4. Ready to develop output*
7. Develop readiness to collect and preserve data
   - *7.1. Ready to collect data across range of subjects*
   - *7.2. Ready to collect data across range of sources*
8. Develop readiness to analyse data
   - *8.1. Ready to analyse of what happened and how*
   - *8.2. Ready to develop hypotheses*
   - *8.3. Ready to Identify of norms, novelties and deviations*
   - *8.4. Ready to analyse underlying causes*
9. Verify readiness

2.2 Discussions about Readiness to investigate

The green paper provided the basis for discussions with organisations which we had identified as having a special interest in their ability to investigate. We met with:

- AIB, the UK Air Accident Investigation Branch
- DSM Elastomers (The Netherlands)
- The Dutch Safety Board/Onderzoeksraad Voor Veiligheid
- INERIS, Institut National de l'Environnement Industriel et des Risques, France
- Jane Paul (Independent worker's advocate and researcher)
- Marathon Oil, UK
- RAIB, UK Rail Accident Investigation Branch
- Rolls Royce plc, UK.

In addition, we received comments from others, including Prof. Peter Waterhouse (now retired from Surrey University) and the UK Engineering Employers Federation.

2.3 The DORI White Paper

The discussions around the green paper, convinced the present authors that a detailed developmental model, although perceived as intriguing and thought-provoking, was unwieldy for practical application. This encouraged us to approach the question of investigative readiness by staying much closer to the principles stated by Nertney (1989) for deriving criteria for the terms "right" and "proper" that appear in his definition of operational readiness.

2.3.1 Generic list of investigative tasks

What seemed necessary was a list of generic investigation tasks. This would help to both define the subject matter and to stimulate the reader's development of a list that reflected the specifics of their context. We aimed for a list that was as short as possible. What we produced was derived from the list of tasks developed by RoSPA in 1998 as part of a research project conducted into the investigative practices of companies in the Societies "high performers" scheme. This list was modified in the light of a task list produced by the "*Experimental on-line Investigation Research Project" and published by the* 'Investigation Process Research Roundtable' (the list is reproduced in Appendix 1), and in response to comments received later once a draft of the white paper had been published.

The final task list of 34 generic tasks is:

(1) Recognise that something significant has happened
(2) Rescue, first-aid & make safe
(3) Notify of occurrence
(4) Inform families (initial & updates)
(5) Preserve/manage scene
(6) Collect (early) statements
(7) Assign the level of investigation
(8) Select team
(9) Inform workforce (initial, plus updates)
(10) Inform customers (initial, plus updates)
(11) Inform insurers and regulators
(12) Inform public and media
(13) Develop terms of reference
(14) Enable/advise/protect Team
(15) Manage team
(16) Liaise with other investigation teams
(17) Catalogue evidence
(18) Record visual data
(19) Collect documents and logs
(20) Collect equipment and material evidence
(21) Collect environmental evidence
(22) Interview witnesses
(23) Structure what happened and how
(24) Develop alternative lines of enquiry
(25) Evaluate/Test hypotheses
(26) Identify controls and barriers
(27) Identify root causes
(28) Write reports
(29) Develop remedial actions
(30) Review investigation
(31) Debrief team
(32) Debrief affected staff/others
(33) Manage recommendations
(34) Return, archive or dispose of evidence

2.3.2 The DORI framework emphasises context.

Although the tasks may be generic, how these tasks will be performed varies greatly with context. Therefore, in the DORI white paper, we recommended that organisations develop criteria for specific types of investigations rather than for an undifferentiated whole.

For a given type of investigation, the generic task list provides an exemplary set of "what's" to which the corresponding "how's" have to be found. The operational readiness definition from Nertney (1987) provided a basic method for describing how to develop the criteria for how the tasks should be done. This method is annotated (a) to (d) below (from Kingston et al., 2007).

(a) Determine the range of incidents that need to be catered for as part of a planned approach to investigation. This will determine the different investigative contexts for which readiness is to be achieved. Some organisations call each context a ‘level’ or ‘class’ of investigation. Each context may require different things from different people, albeit within a broadly comparable investigative framework.

(b) Determine the tasks to be done in the course of investigating incidents. These range from recognising that an incident has happened to reviewing the conduct and results of the investigation when it has been concluded.

(c) Establish criteria for how the tasks should be performed. In the operational readiness philosophy, there are three sources of criteria: functional, risk-based and

'codes, standards and regulations'. The criteria determine what is appropriate for each task depending on the category of the incident:

(i) functional criteria: the investigation tasks are performed in a way that is acceptable to the managers of the investigation and those to whom they are accountable;

(ii) risk-based criteria: the investigation is performed in a way that delivers acceptable risks to the people, assets, quality, timeliness and cost of the investigation. This could also include risks to reputation, pertaining to the investigation process, the individual investigators or the body responsible for the investigation;

(iii) applicable codes, standards and regulations: these include CS&R established at all control levels inside and outside of the body responsible for the investigation.

(d) Determine the resources and arrangements required to perform the tasks. Resources and arrangements can be grouped into three elements: (i) people, (ii) plant & equipment, and (iii) procedures & management controls

2.3.3 The Nertney Wheel model of Operational Readiness

The elements of people, plant/equipment and procedures/management controls provide the basis for Nertney's model of operational readiness (Nertney, 1987) which has come to be known as "the Nertney Wheel".

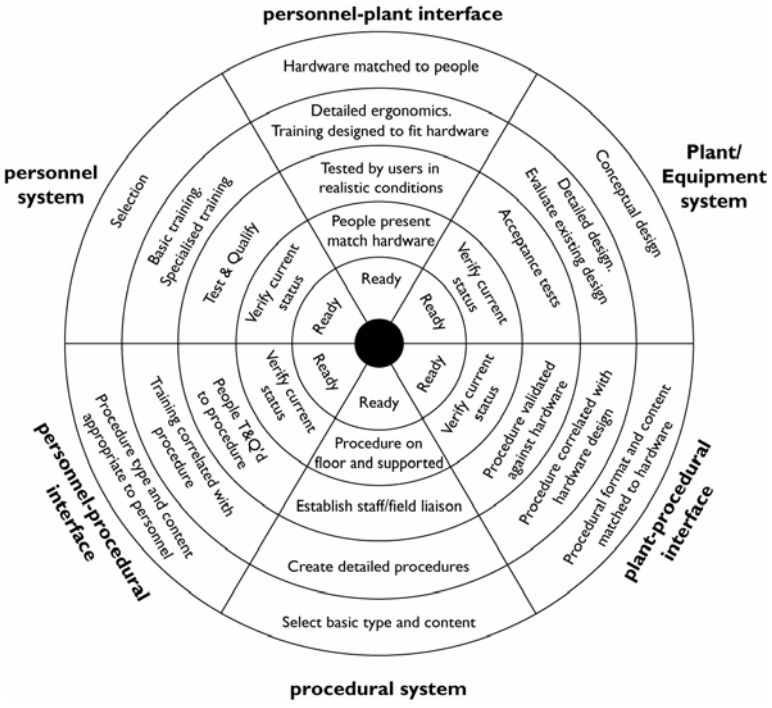

Figure 1. The Nertney Wheel (After Nertney, 1987)

As explained in Kingston et al. (2007; p.4-5), *"The outside of the circle represents the beginning of the development process: at this point none of the developmental tasks needed to achieve readiness have been started. The segments of the circle alternate between subsystems and interfaces. The subsystems correspond to the three elements discussed earlier— People, Plant & Equipment, and Procedures & Management controls. Each of these subsystems needs to be developed in step with the others. Each concentric circle represents a step. For example, the selection and training of personnel needs to keyed to the procedures and management controls for the operational tasks that need to be performed. Similarly, the design of procedures and management controls needs to take account of the characteristics and needs of the people who will actually use them. Within a given investigative context (e.g. "major" accident investigation), every task identified within the operational readiness definition needs to be considered in "Nertney Wheel" terms. This produces a catalogue of development tasks to be undertaken within a project to develop operational readiness to investigate"*.

2.3.4 Downloads

Copies of the DORI White paper (Kingston et al., 2007, and the draft versions which preceded it) are downloaded from the NRI web site at the rate of around 80 copies per month. This volume makes DORI the most popular of the papers on the website, but not as popular as the various manuals (such as those concerning analytical methods of accident investigation) which are also available there. In general, the document has been well-received.

3 Next Steps

The DORI White paper mentions the developmental steps needed to establish readiness to investigate but does not describe how these should be done. As a way of developing this programmatic know-how, RoSPA hopes to identify partners to set-up investigation readiness pilot programmes. However, so far, although there has been interest, no pilots have been set-up.

In discussion within RoSPA's "Partners in Progress" group (which consists mostly of the safety managers from various UK companies and public sector organisations), the most attractive approach appears to be thematic. Rather than establishing readiness programmes for accidents in general, it is seen as more attractive (and conducive to cross-sector co-operation) to set-up readiness programmes for specific classes of accidents such as those involving transport (e.g. workplace transport and road vehicle accidents).

However, there seem to be two main obstacles to these pilot programmes. First, the phrase "readiness to investigate accidents" is thought to be rather aversive to top-management. Our respondents believe that top managers tend to perceive this as tantamount to "readiness to have accidents". For this reason we have contemplated re-branding the initiative as "*readiness to learn*" and, to deserve the title, broaden the scope to include the wider issues of organisational learning.

The fact remains that accident investigation, despite the focus it gives to learning lessons and improving, can be seen as threatening and problematic. More campaigning and better marketing will be needed to break-down managerial prejudices towards this subject.

4 References

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Investigation Task list for one or two person investigation project.

Modified Task List for EIR [Experimental on-line Investigation Research] Project[1]

(Ludwig Benner, 6 March 1998)
Draft 09 October 1997

This material (and variations on the task list) are available from the web site of the 'Investigation Process Research Roundtable'; URL (at the time of downloading) http://www.iprr.org/3PROJ/AITasklist.htm.

1. Pre-field investigation
   - 1.1. Select investigation methodology/protocols
   - 1.2. Design AI tasks to take full advantage of available resources.
   - 1.3. Identify and define perceived self interests of everyone affected by investigation
   - 1.4. Negotiate with others who might be investigating
   - 1.5. Identify and control personal risks to investigator
   - 1.6. Define and order investigation tasks

2. Field investigation tasks
   - 2.1. Do walk-around/look-around to familiarize self with scene
   - 2.2. Identify physical objects likely to change
   - 2.3. Identify people data likely to change
   - 2.4. Protect data sources against premature change
   - 2.5. Formulate questions to generate needed data
   - 2.6. Document post-occurrence physical states
   - 2.7. Define pre-occurrence physical states of involved objects
   - 2.8. Define physical changes (damages) during incident
   - 2.9. Document post-occurrence physiological states
   - 2.10. Prepare investigation - photographs
   - 2.11. Prepare investigation - sketches
   - 2.12. Prepare investigation - drawings
   - 2.13. Prepare investigation - maps
   - 2.14. Prepare investigation - charts or graphs
   - 2.15. Define pre-occurrence physiological states
   - 2.16. Define physiological changes (injuries) during incident
   - 2.17. Identify and define change makers that produced outcome
   - 2.18. Define actions required to produce observed ending conditions
   - 2.19. Acquire data about interactions from witnesses
   - 2.20. Acquire data about interactions from object sources
   - 2.21. Transform observations into form entries
   - 2.22. Transform observations into event descriptions
   - 2.23. Organize events sequentially
   - 2.24. Focus energies on remaining unknown events

[1] A summary of the EIR project's results can be found at http://www.iprr.org/3PROJ/3EIRstat.html

2.25. Select events to break down or decompose
2.26. Define events pairs or sets for logic testing
2.27. Apply cause-effect logic to events pairs and sets
2.28. Demonstrate causal relationships among interactions
2.29. Define gaps in understanding of what happened
2.30. Hypothesize bounded scenarios to fill gaps
2.31. Acquire data to verify hypotheses
2.32. Develop plans for any testing/simulations
2.33. Apply necessary/sufficient logic to events
2.34. Separate relevant from irrelevant events/data
2.35. Do QC check of final description
2.36. Use events description to define problem relationships
2.37. Use events description to evaluate problems or needs
2.38. Assess gravity of each need (fix/don't fix)
2.39. Select problems/needs to address with recommendations
2.40. Identify candidate actions to address problems or needs
2.41. Use events sets to evaluate each candidate recommendation
2.42. Develop rationale for selecting recommendations to be proposed
2.43. Develop recommendations effectiveness assessment plans and procedures
2.44. Do objective quality assurance procedures for final investigation outputs

3. Post-field investigation
   3.1. Prepare narrative description and explanation of what happened
   3.2. Pick a cause, causes, causal factors, root cause, proximate, remote, errors or whatever.
   3.3. Prepare final report
   3.4. Defend final report
   3.5. Respond to media inquiries
   3.6. Do objective quality assurance procedures investigation process
   3.7. Arrange for disposition of wreckage/debris/test objects
   3.8. Arrange for archiving of data sources

4. Lead investigator
   4.1. Set daily task priorities for each investigator or group
   4.2. Manage work force performance
   4.3. Assure needed information exchanges among workers
   4.4. Conduct public and private briefings
   4.5. Manage quality assurance procedures for team tasks and outputs
   4.6. Manage recommendation development process
   4.7. Manage report preparation

5. Multinational investigations
   5.1. Implement multinational investigating protocols
   5.2. Implement customs and conventions of host state
   5.3. Manage multicultural multinational investigation teams
   5.4. Negotiate participation by non-government experts
   5.5. Critique investigation process