

BUILDING SYSTEM RESILIENCE THROUGH MULTI-DISCIPLINARY AND CROSS-DIVISIONAL REGIONAL RESILIENCE TEAMS

Malcolm Van Harte
vhartem@eskom.co.za

Robert Koch
robert.koch@eskom.co.za

Jose Correia
CorreiaJ@eskom.co.za

Gunter Rohde
RohdeG@eskom.co.za

System Operations & Planning Division
Eskom Holdings Limited

ABSTRACT

This paper describes some of the structures and processes implemented to build resilience across the various divisions of a vertically integrated utility (Eskom¹). The aim in implementing these was to: enhance its ability to identify, anticipate; and adapt rapidly to threats and vulnerabilities; operate at elevated levels of stress without failure for extended periods of time; build the capacity to respond and recover from a disturbance; and learn from near misses and events.

This paper describes Eskom's Regional Resilience Teams and how they relate to Eskom's Integrated Risk Management (IRM) Framework, Eskom's Integrated Emergency Response structures and protocols [1,2], and Eskom's normal business processes [3]. The paper also illustrates how these contribute to a greater degree of organisational "mindfulness" in relation to the potential for failure - and the manner in which management and staff recognise, prioritise, and mobilise to address areas of potential failure [4,5].

1. INTRODUCTION

After experiencing a significant regional power system constraint in 2006, Eskom initiated a re-design of its emergency structures and protocols – with the aim of facilitating a more coordinated response to power system emergencies across generation, transmission, and distribution boundaries. These structures and protocols were stress-tested during national load shedding experienced in 2008 (when system demand outstripped available generation capacity in South Africa) [6]. Modifications were subsequently made to these structures and protocols and to the way in which Eskom identifies and manages risk². One of the initiatives to better manage power system risks was the implementation of Regional Resilience Teams (RRT's). These structures integrate business units (i.e. generation, transmission, distribution, capital build programme) and various functional areas (i.e. technical, customer services, stakeholder management, and risk management).

2. RESILIENCE

Resilience is more than simply "the ability to bounce back" after a failure – an organisation seeking to be highly resilient needs to also continuously focus on aspects related to the *potential* for failure at all levels of the organisation.

With this in mind, Eskom defines *resilience* as the inherent ability to: (i) *identify, anticipate, and adapt rapidly to threats and vulnerabilities arising from changes in the internal & external environment*; (ii) *operate at elevated levels of stress without failure for extended periods of time*; (iii) *respond to a shock by containing the impact (severity/duration) of the event*; (iv) *recover quickly in a coordinated manner*; and (v) *implement learning from near-misses and recovery experiences*.

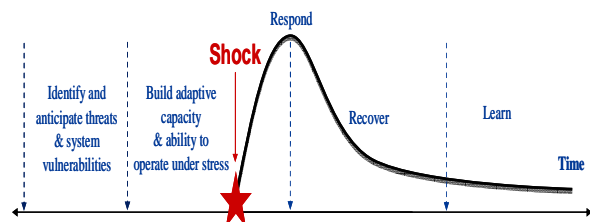


Figure 1: Attributes of resilience.

Whilst structures and processes play an important role in establishing these attributes, highly reliable organisations inherently reflect these in their culture – i.e. in "the way things are done" in the organisation [4]. Development of such a culture needs to be facilitated by leadership that has collectively resolved to build the capacity to recognise risks, prioritise the actions required to address these, and mobilise resources to implement these actions [5]. This paper focuses on management of the integrated power system, and some of the systems (structures and procedures that support decision-making) and organisational accountabilities that have been implemented in Eskom to facilitate the process of building a Highly Resilient Organisation (HRO). These key elements are illustrated in Figure 2.

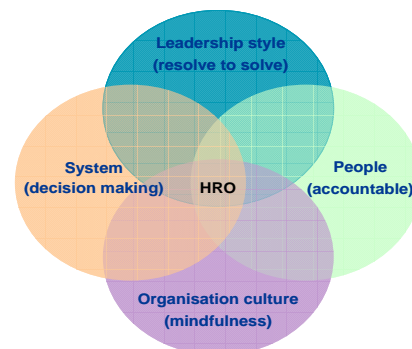


Figure 2: Key elements of a highly resilient organisation.

An effective risk management framework constitutes one such decision making system. Resilience is an organisational trait, and not a "new function" in the organisation.

¹ Eskom is a vertically integrated, South African state-owned electricity company, established in 1923. The utility is the largest producer of electricity in Africa, and is among the top seven utilities in the world in terms of generation capacity and among the top nine in terms of sales. (www.eskom.co.za)

² Definition of Risk = "Effect of uncertainty on objectives" [ISO 31000:2009]

3. INTEGRATED RISK MANAGEMENT

3.1. Background

Integrated Risk Management (IRM) has been practiced in Eskom for many years – with varying degrees of success. After the 2008 capacity crisis Eskom conducted an extensive review to identify the gaps and opportunities for improvement in the existing IRM framework. The outcome of this review was a complete overhaul of Eskom’s risk management framework – including adoption of the new ISO 31000:2009 standard [7].

3.2. Overview of the IRM framework

Eskom’s IRM policy and revised standards aim at establishing a uniform approach to risk management across all its strategic and operational decision-making processes. Key to this framework are: (i) establishment of the *context* in which risks are assessed; (ii) risk ranking and prioritisation based on common *consequence and likelihood criteria*; (iii) leadership resolve to ensure that *treatment* is timely and effective; and (iv) effective *communication, monitoring, and review* systems. The process is summarised in Figure 3.

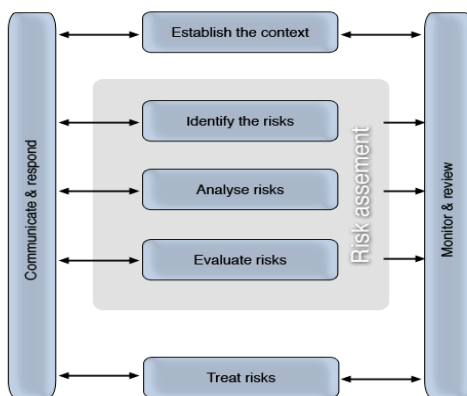


Figure 3: Integrated Risk Management process [7]

Common consequence and likelihood criteria are applied across the organisation. These consequence criteria address the following areas: (i) financial impact, (ii) people effects (iii) environmental impact, (iv) brand and reputation, (v) legal and compliance, (vi) continuity of supply.

Risks identified throughout the organisation are captured on a central database. This enables access to these risks by the whole organisation. It also enables communication and review of these risks through standardised reporting and queries.

The various attributes of a resilient organisation (Figure 1) can be communicated in the context of the risk management framework by considering six key stages (**R**⁶):

- (i) **Recognition:** *of threats and vulnerabilities that give rise to business risks (i.e. uncertainty of meeting defined objectives).*
- (ii) **Reduction:** *of the potential consequences and/or likelihood associated with these risks - through prioritising and implementing effective controls and treatment plans;*
- (iii) **Readiness:** *effective emergency planning in order to respond should identified risks materialise (or unexpected events occurring)*

- (iv) **Response:** *the necessary capacity (structures, protocols, and systems) to respond to any type of events;*
- (v) **Recovery:** *effective business continuity plans*
- (vi) **Reflection:** *post-event analysis with the aim of capturing organisational learning.*

When it comes to the integrated power system, effective risk management requires integration across various areas of the business. Recognising this (through events such as the regional capacity constraint in 2005/6), Eskom has formalised specific structures and accountabilities across the country to facilitate a more integrated approach to risk management.

4. REGIONAL RELIABILITY TEAMS

4.1. Objective

Regional Resilience Teams (RRT’s) have been established and aligned with Eskom’s six distribution areas across the country. Their specific objective is to develop and maintain *a consolidated and common leadership view of supply risks and associated societal resilience in a given region*. The intent behind their establishment was to continue to evolve Eskom’s organisational culture from a largely event-driven (reactive) culture, to a culture that is characterised by proactive attention to the potential for failure (i.e. threats, vulnerabilities, and small failures).

4.2. Risk identification and management

Risk identification is undertaken from a “bottom-up” and a “top-down” perspective. The “bottom-up” perspective is facilitated by establishing risk management as a requirement at all levels of the organisation – supported by an extensive risk management training programme. The “top-down” perspective is guided by specific risk categories identified to ensure that all aspects are regularly reviewed. These categories are i.e. (i) *load growth*; (ii) *system adequacy*; (iii) *operational risks*; (iv) *security risks*; (v) *emergency preparedness*; (vi) *customers*; (vii) *stakeholders*; (viii) *audits, reviews, and post-mortems*.

4.3. Integration with normal business

A distinct concern when prioritising treatment plans across functional areas (system operations, grid operations & maintenance, system planning, customer services etc) as well as business areas (generation, transmission, distribution) is the different perspective that each of these areas may have on a particular risk.

For each of the identified risk categories, a review of business processes is being undertaken to enhance the integration between functional and business areas. For example, the prioritisation of treatment plans by the transmission grid planning department is influenced by both technical assessments of system vulnerabilities by the System Operator, as well as a review by the various functional and business areas of the risks in accordance with the company risk criteria (consequence and likelihood).

The RRT’s further provide a good mechanism for tracking the implementation of corporate initiatives aimed at improving the resilience of the organisation and the county - such as the implementation of new policy or procedures which require interaction between various parts of the

business. A good example is the implementation of the national code of practice for emergency load shedding and restoration – which requires interaction between customers, distributors, and Eskom divisions [2].

4.4. Escalation of risks

One of the shortcomings identified in the review of Eskom’s previous risk management framework was the inadequacy of the risk escalation process. Risks identified by the Regional Resilience Teams are escalated through several channels. Regular presentations are made to the operational meeting of Eskom’s executive management committee. These have demonstrated to be an effective means of ensuring executive oversight. The priority 1 risks are also tabled at the risk committee meetings of the Eskom Board. Risks identified by the RRT’s are actioned through the individual divisional executive teams. Table 1 summarises the risk escalation requirements – i.e. the level at which a risk with a given priority need review and approval of the treatment plans.

Table 1 – Risk escalation requirements

Ranking	Review and approval of treatment plan by:
Priority 1	Executive Committee & Eskom Board
Priority 2	Divisional Executives & Exec Sub-Committee
Priority 3	Business Unit General Managers
Priority 4	Senior Managers

5. INTEGRATED EMERGENCY STRUCTURES

5.1. Objective

An emergency is by its nature chaotic and therefore emergency structures, facilities, and protocols are required to coordinate an effective response to an impending or actual emergency. *“The ability to deal with a crisis situation is largely dependent on the structures that have been developed before chaos arrives. The event can in some ways be considered as an abrupt and brutal audit: at a moment’s notice, everything that was left unprepared becomes a complex problem, and every weakness comes rushing to the forefront”* [8].

An electrical power system is essentially passive, and responding to supply interruptions and plant outages is a day-to-day activity in the operational divisions of a power company – i.e. the normal business of a utility is to handle these events as they arise. An emergency may be defined as: *“an event which cannot be handled by the normal business resources and processes of the utility in question [1]”*.

The key objective with the establishment of integrated emergency structures and protocols is therefore to ensure an effectively coordinated response to events that exceed the boundaries of what constitutes “normal business” – i.e. events that could otherwise escalate to a major crisis for the company. Key criteria in the establishment and maintenance of emergency preparedness protocols & structures are that these are: (i) fully integrated within internal and external structures; (ii) regularly tested & assured; (iii) demonstrate a high level of preparedness for all kinds of emergencies that could affect the functioning of the power system.

5.2. Structures

To effectively coordinate a response, a national Emergency Response Command Centre (ERCC) has been established to coordinate the emergency protocols across the regions with support from Regional Joint Command Centres (RJCC’s). These structures are only activated in the event of an emergency. In the event of a regional emergency, the relevant RJCC is established. Venues are equipped with a range of communication technologies namely video and teleconferencing facilities.

5.3. Mandate

When an emergency is declared by the standby chairman, emergency powers are invoked. This mandate is only available for emergencies, in other words situations in which Eskom’s normal processes will not handle the speed required for an acceptable resolution of the situation. The triggers for such an emergency declaration were originally only related to the power system however, the usefulness of the system has been demonstrated for many kinds of emergencies, including the mentioned strike in mid 2010 FIFA World Cup™ in South Africa.

5.4. Protocols

Emergency protocols have been defined to provide structure in a potentially chaotic situation (see Figure 4). Annual scenario testing is conducted on a national and regional level. The national tests involve all the structures and tele-conferenced committees play out the scenarios across the country.

The Alert phase of the protocol allows management of a potential crisis where emergency power are not required – i.e. the ERCC/RJCC’s play a strong coordinating and monitoring role.

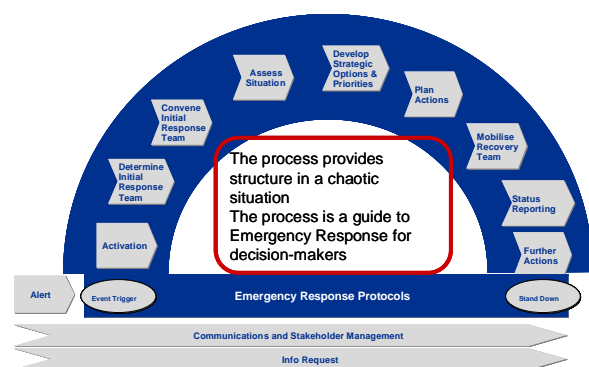


Figure 4: Emergency response protocols

The ERCC and the RJCC stand down after an emergency has been managed and recovery complete.

5.5. Relationship to the Regional Reliability Teams

The Regional Reliability Teams are accountable for reviewing the readiness of the Regional Joint Command Centres, for specific emergency preparedness plans in the various divisions, and for overseeing the implementation of learning after the event. Figure 5, illustrates the oversight role of the RRT and highlights that activation of the RJCC only occurs during an emergency condition. The RJCC will oversee containment of the severity of the emergency – relying on both its command capabilities and the

groundwork laid by the RRT in establishing suitable contingency plans for identified risks.

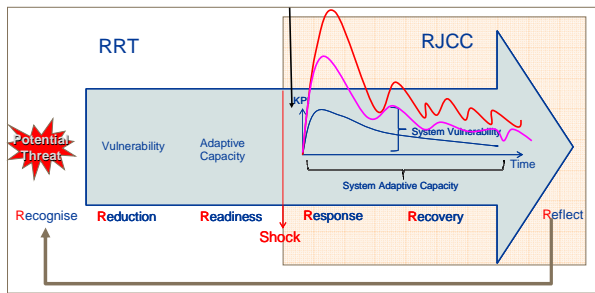


Figure 5: Relationship between the RRT's and RJCC's.

6. VISUALISATION

The ability to anticipate and identify threats and vulnerabilities is a necessary pre-requirement for ensuring an appropriate response. Eskom is pursuing enhanced visualisation at many levels in the organisation (ranging from implementation of an Integrated Generation Control Centre - which tracks detailed power station parameters across Eskom's generation fleet, to an Operational Health Index that acts as a "wide net" to track operational vulnerabilities across the organisation for the operations sub-committee of Eskom's Executive Management Committee).

In preparation for the hosting of the 2010 FIFA World Cup™ in South Africa, the need was identified for improved visualisation of threats related to the supply to FIFA venues and other key sites. This resulted in the establishment of temporary structures (Situational Awareness Centres) at national and regional level. Supply-related threats to specific event-related sites were visible at national level. The value of this information contributed to decision to establish a permanent nerve-centre to provide senior management with situational information on the status of supply to customers as part of Eskom's new business model.

7. CONCLUSIONS

Whilst it may be true that "resilience is something you realise after the fact [8]", the challenge remains as to how the level of resilience of an organisation can be enhanced and evaluated before a crisis emerges. Furthermore, no organisation can predict all its failure modes or have planned up front for unexpected changes in the internal and external environment in which it operates.

This paper has proposed a general framework for institutionalising some aspects of organisational resilience through: (i) improved integration across business areas and functions; (ii) a common risk management framework to establish clear communication on the nature of specific risks; (iii) escalation processes to ensure prioritisation of risk treatment plans, and; (iv) a clear alignment between the "normal" business and the "abnormal" requirements associated with a response to a crisis.

Whilst resilience can be enhanced through institutionalised risk management processes and improved integration across the business, the true benefit of the

structures discussed relates to the manner in which an elevated level of "mindfulness" is entrenched as a culture in the organisation.

This elevated level of "mindfulness" is considered by as having played a significant part in Eskom's contribution to the successful hosting of the 2010 FIFA World Cup™ in South Africa.

Acknowledgments

The authors wish to acknowledge Eskom's leadership team, in particular: Erica Johnson, Kannan Lakmeharan, and Greg Tosen for their enthusiastic envisioning and sponsorship of the resilience initiative; the RRT leadership teams and coordinators for their excellent support and leadership in the implementation process; Gavin Brice, Juan la Grange, Angie Dubbini, Vanessa Carpal, and the Deloitte Consulting team for their role in the review and establishment of the emergency structures and protocols, and; Christopher Palm and Grant Purdee (Broadleaf Consulting) for development of the new IRM framework.

8. REFERENCES

- [1] A.J. Correia, R.G. Koch, Integrated Power System Emergency Preparedness - Framework and Implementation in South Africa, Paper 85, Cigré Symposium, Recife, Brazil, April 2011.
- [2] R.G. Koch, J. Correia, A. Dold, D. Marais, P. van Niekerk, M. Motaung, M. Mncube, P. Johnson, (on behalf of the NRS 048 WG), National Code of Practice: Emergency Load Reduction and System Restoration Practices (NRS 048-9:2009), AMEU Convention, Port Elizabeth, South Africa, 28-30 Sept 2009
- [3] M. Van Harte, R.G. Koch, M. Nene, G. Havford, M. Bala, Integrated Risk Management and System Adequacy Assessment: Implementation of the ISO 31000:2009 Standard in the South African Power System, Paper 84, Cigré Symposium, Recife, Brazil, April 2011.
- [4] K. Weik & K. Sutcliffe, "Managing the Unexpected: Resilient Performance in an Age of Uncertainty", 2nd Edition, San Francisco, John Wiley & Sons, 2007
- [5] M.H. Bazerman, M.D. Watkins, Predictable Surprises - The disasters you should have seen coming and how to prevent them, 2nd Edition, San Francisco, John Wiley & Sons, 2007
- [6] M. Chettiar, K. Lakmeharan, R.G. Koch, A Review of the January 2008 Electricity Crisis in South Africa: A Problem a Decade in the Making, Cigré Southern Africa Regional Conference, August 2009.
- [7] ISO 31000:2009, Risk management — Principles and guidelines
- [8] P. Lagadec, "Preventing Chaos in a Crisis: Strategies for Prevention, Control, and Damage Limitation", London, McGraw-Hill International, 1993, p.54
- [9] Diane L. Coutu, "How resilience works - confronted with life's hardships some people snap, and others snap back", Harvard Business Review, May 2002, p.47