Network Asset Management
Network Technology Plan
Project Note

Note Number	35
Title	Executive Summary
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Version	0.4(a) (draft)
Release Date	
File Name	CCTechnologyPlanExecSummaryForIEEE-DA-WG.doc

Amendment History			
Version	**Release Date**	**Author**	**Notes**
0.1		nah	Outline for comment
0.2		nah	First draft
0.3		nah	Second draft
0.4		nah	Minor corrections
0.4(a)		nah	Copyright notice and disclaimer added for IEEE release.

1. Contents

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3. Purpose

This is the top-level summary document for the network technology planning process undertaken between March 2005 and March 2006. It provides background information, describes the planning process, lists major findings and recommendations, and provides a guide to documentation generated throughout the process.

4. Introduction

The network technology planning process was initiated by General Manager Network Asset Management. His brief was: To develop a technology roadmap that would enable the ENERGEX network business to fulfil its performance obligations over the next 20 years. In this context, “performance” was defined around issues addressed by the EDSD Review and the Queensland Electricity Industry Code – mainly reliability of supply and customer service. The roadmap was to anticipate and use (where appropriate) proven, off-the-shelf technologies at any point in time, but exclude “bleeding edge” technologies.

Phase 1 (SKM consultancy) of the planning process commenced in March 2005. This piece highlighted the fact that ENERGEX should devote significant effort to (a) defining the challenges of the next two decades, and (b) developing its network architecture to meet those challenges. Phase 2 (technology planning phase) commenced in May 2005, with the formation of a technology planning team led by Mike Gregg. Other full-time members included Dr Bevan Holcombe, Merv Joyce, Aidan Roberts and Neil Higgins. Chris Dunn contributed significantly to the work on reliability.

Many other people from inside and outside ENERGEX contributed to the process. Equipment vendors were especially interested and cooperative; no doubt due to their sense that network technologies will have to evolve significantly in the coming years.

5. Motivation

5.1 The Digital Society

Westernised society has a voracious appetite for energy and other physical resources. Electricity has revolutionised energy use by being clean (at the point of use) and easy to use in applications consuming milliwatts to megawatts of power.

Electricity lies at the heart of the "digital revolution" – the rapid increase in affordability of computers and communications devices which is currently driving lifestyle changes. Reliance on electricity by industry and individuals alike has increased expectations for safe, reliable, high quality electricity supplies.

Around the world, electricity infrastructure is receiving qualified “report cards” because of its perceived inability to fulfil these expectations. In the USA, the Department of Energy and the Electric Power Research Institute (EPRI) have responded with “Gridwise” and “Intelligrid” respectively – projects with a mission to modernise electricity infrastructure from producer to consumer through the use of advanced communications and computing technologies.

5.2 The EDSD Review and the Queensland Electricity Industry Code

The August 2004 report of the review of Electricity Distribution and Service Delivery in Queensland recommended an overhaul of asset management and service delivery operations to improve network performance and customer service. The message was clear: The capacity limitations and storm response problems of the previous summer should not be repeated.

The Electricity Industry Code extended and codified parts of the EDSD Report by:

- Requiring the preparation of annual management plans for ENERGEX’s network
- Setting minimum service standards (SAIDI and SAIFI limits by feeder type)
- Setting Guaranteed Service Levels (GSLs) and requiring ENERGEX to pay rebates to non-contestable customers whenever those service levels are not met
- Requiring ENERGEX to report to the regulator on its performance against the minimum service standards and GSLs

Again, the message was clear: Using transparent processes, network performance and customer service should be improved to acceptable levels, or ENERGEX should incur financial penalties.

5.3 Regulatory Environment

The EDSD review and its aftermath are a portent of things to come. For monopoly businesses such as electricity networks, the worldwide trend is toward higher standards, tighter regulation and closer scrutiny.

Higher standards reflect the expectations of the “digital society”. Service quality incentive schemes (so called) put explicit dollar values on network KPIs relative to targets. The Victorian regulator already has such a scheme in place. This concept will probably be implemented in all States under a National Regulator.

Tighter regulation reflects the need for prudent economic behaviour. To obtain adequate funds, network businesses will have to substantiate their asset management policies with internal studies and external benchmarking data. Whole-of-life (20-50 years according to the type equipment) asset management plans will be needed.

Closer scrutiny reflects the need for transparency and professionalism. The Queensland Electricity Industry Code already requires ENERGEX to publish its five-year programme of work. In New South Wales, network businesses must convince the regulator that demand-side options have been fairly evaluated as an alternative to network augmentation. This trend will continue – the level of rigour required by regulators will continue to increase.

6. Approach

6.1 Phase 1

The first phase was undertaken by Cliff Jones, Greg Edwards and Ben Kearney of Sinclair Knight Merz (SKM). Their brief was to define a network vision and subsequently elucidate a strategic technology plan for ENERGEX's electricity distribution network. In scope were network-related disciplines (technologies, philosophies and practices) directly affecting network performance in general and reliability in particular; implications for workforce skills and size; and regulatory issues.

To background their deliverables, the SKM team compared ENERGEX figures on reliability and reliability spend with figures from other Australian and overseas companies. This comparison showed that ENERGEX's performance and spend have been below those of comparable Australian utilities, and far below global best practice.

The fundamentals of high reliability cited in the report are:

- Reduce the frequency of faults
- Reduce the number of customers affected by each fault
- Reduce outage durations

SKM's report included an order of merit for reliability improvement strategies based on generic cost/benefit arguments. High-ranking strategies were those capable of quick returns at modest cost, such as the use of automatic reclosers and sectionalisers. Lower-ranking strategies included measures to improve equipment failure rates (such measures usually take time to achieve coverage of the network and return measurable benefits). Lowest ranking were capital-intensive measures taking a long time to implement, eg. reconductoring and construction of new zone substations. The report concluded with a proposed timetable for the execution of reliability improvement strategies, based on the foregoing order of merit.

The SKM team provided many useful insights. It became apparent, however, that in order to develop actionable findings and recommendations for ENERGEX, internal staff would have to be engaged to extend and refine SKM's work.

6.2 Phase 2

The second phase developed along the following lines:

Stakeholder analysis

To properly qualify as a strategic technology plan, the output of the process should be traceable to anticipated stakeholder expectations over the period of the study.

In the stakeholder analysis section, stakeholders and stakeholder expectations were identified. An improvement ranking (need for improvement) was derived for each expectation using subjective scores for current performance, and current and future emphasis (importance).

Four "strategic areas" (themes) emerged from this process: Reliability of Supply; Quality of Supply; Demand Management; and Customer Service. Five-, ten-, fifteen- and twenty-year KPI targets were developed for each strategic area.

Data gathering and benchmarking

Limited data gathering and benchmarking generally confirmed SKM's findings about the performance of the ENERGEX network relative to other comparable networks.

The main sources of data for this analysis were NFM for network data and NO for outage data. Both data sources are reliable for operational purposes; however the ever-changing configuration of the network makes it difficult to construct reliable historical views. For example, when a new zone substation is constructed, the tail-ends of existing feeders become the head-ends of "new" feeders supplied by the new substation. It is not uncommon for these head-ends to be upgraded, thereby breaking the nexus between outage data and age data for the feeder equipment. From about 2000 onwards, NFM has been capable of reconstructing the network "as of" a defined date. Prior to 2000, there is no remedy. In addition, NFM does not keep historical data for crossarms (the breakage of which is a common cause of outages).

Interviews and workshops

The technology planning team convened interviews and workshops to cover all relevant engineering disciplines. Subject experts from within and outside ENERGEX were asked to review network and equipment performance; air their concerns; provide their analyses and opinions; and describe new technologies and trends.

The power transformer workshop was a full day event which, due to the large number of interested parties, was held off site. Representatives of Wilson Transformer Company (ENERGEX's current supplier of power transformers) and Cooper Power attended the workshop. Subjects covered included: Design and construction; Loading (utilisation versus use of life); Condition assessment; Online condition monitoring; New materials (FR3 coolant); Life extension techniques; and Procurement specifications. Through the day it because obvious that ENERGEX should modernise its transformer procurement and management practices.

Other significant workshops covered underground cables and network automation.

Analysis

For each of the four strategic areas (Reliability of Supply, Quality of Supply, Demand Management and Customer Service) analysis typically involved a reprise of KPI targets; a cause and effect analysis; the construction of a strategic vision and benefits realisation framework; and the development of short-term and long-term improvement strategies. The team attempted at all times to analyse *systems*, not components.

The first strategic area, Reliability of Supply, was judged to be the most important in the short term (2-5 years). Accordingly, it received the bulk of attention in this part of the process. High-level studies confirmed that substantial (30-80%) reliability improvements can be achieved through the use of reclosers, sectionalisers, load transfer switches and line fault indicators, especially when remotely controlled.

At that time, Messrs Gregg and Holcombe were also engaged in the development of CAPEX and OPEX scenarios for the current regulatory period. The two streams of work converged to give a clear idea of the spending levels that would be necessary to achieve sustainable reliability improvements.

7. Major Findings

The major findings of the technology planning process are summarised in the following sections.

7.1 Need to Get the Basics Right

In this context, “the basics” refers to the fundamental engineering skills and practices which underpin a successful, long-term network business. In recent years, ENERGEX has been subjected to significant commercial pressures, which have resulted in the erosion of these skills and practices.

Strategies related to this finding include:

- Improve technology planning methodology
- Carry out fundamental research and development
- Adopt industry and global standards
- Evaluate nascent products and systems
- Develop network architecture
- Develop infrastructure architecture
- Implement shared infrastructure
- Develop workforce skills and knowledge
- Improve asset management practice

7.2 Need to Improve in All Areas

KPI targets for all four strategic areas are predicted to tighten significantly over the 20-year planning period. Given that ENERGEX’s resources are already stretched to keep pace with demand growth in south-east Queensland, this poses a particular challenge. However, ENERGEX should not put off addressing areas other than capacity. Doing so will increase business risk under future regulatory regimes - targets in some other jurisdictions are already more onerous than for ENERGEX, meaning that ENERGEX will have to improve to meet those targets, then improve again to keep pace with rising expectations.

7.3 Central Role of Architecture and Technology Planning

Every rational action is motivated by one or more objectives. At the highest level, these objectives are often summarised in a mission statement.

The mission statement says what must be achieved. How it will be achieved is stated, at increasing levels of detail, in strategies and plans. Where the objectives relate to a physical system, the system *architecture* is a fundamental determinant of whether mission fulfilment will be possible. Architecture is the fundamental organisation of a system embodied in its components, their relationships to each other and the environment, and the principles guiding its design and evolution.

The architecture is evaluated in terms of the ability of the ensuing system to fulfil its mission. It is described in documents such as principles, policies, standards and guidelines.

The “digital society” is demanding ever higher reliability and quality of supply. Regulators are demanding ever higher performance across a range of technical and economic measures. A review of the ENERGEX electricity network architecture is needed to ensure that future performance targets can be met. Consequent changes will have to be made to planning guidelines, standard building blocks, equipment specifications, design standards and construction standards.

7.4 Central Role of Communications and Computing as Enabling Infrastructure

Communications and computing are already essential for planning, design, construction, maintenance and operation of the power system. Even so, every recent review of electricity

infrastructure, every conference and every corridor conversation, is replete with talk about the role of communications and computing in the power system of the future. The key areas for new applications will be network automation (to improve reliability and quality of supply); market operation (to ensure that pricing is cost reflective in as close to real-time as possible, and that demand can quickly respond to price); and customer service (direct communication with customers and field staff).

In future there will be not one network, but many – the distribution network and several communications networks. The communications networks will be tailored to the demands of specific applications (eg. automation, metering, field force automation) and to guarantee the necessary security and performance their use will be restricted to those applications.

Provisioning will be through a combination of commercial services and ENERGEX-owned infrastructure. Business cases for ENERGEX-owned infrastructure will be easier to sustain to the extent that services can be on-sold to commercial users. For example, Broadband over Power Line (BPL) technology seems well suited to applications in metering, demand management and customer service – excess bandwidth could be used by entertainment or internet services.

It is crucial that ENERGEX commence the planning and prudent implementation of such infrastructure, so that value-adding applications will not be delayed.

8. Recommendations

There are 182 specific recommendations organised under 77 activities, 25 strategies, five objectives and 33 initiatives. Each recommendation has been assigned an owner, a manager and a time frame (1-2 years, 3-7 years or 8-15 years).

The recommendations are organised in three “views” as follows:

Deployment view

In the deployment view, objectives own strategies, which own activities, which own focus areas / work packages (see Figure 1). The 182 focus areas / work packages are the recommendations of the planning process. This hierarchy reflects the process whereby stakeholder expectations are deployed into an organisation.

Appendix 1 is a list of focus areas / work packages according to this hierarchy.

Systems view

In the systems view, the top level groups are called initiatives. Each initiative is a collection of focus areas / work packages with a common theme.

Any given focus area / work package may be associated with one or many initiatives, of which only one is the “owner” initiative. The other initiatives are “related” initiatives (see Figure 1). Initiatives thus provide alternative contexts in which to position focus areas / work packages – contexts which are not as linear or clinical as the objective-strategy-activity hierarchy.

Initiatives typically cut across conventional organisational boundaries. This highlights the need for “systems thinking” in the implementation of the technology plan.

Appendix 2 is a list of focus areas / work packages by initiative.

Each initiative and its focus areas / work packages are described in detail in an “initiatives” document. The initiatives documents are derived from a common template and contain: References; Context; Scope and deliverables; Benefits and costs; Timing

and resource requirements. Note: The task of the technology planning team was to *identify*, not *implement* - owners and managers will be responsible for the preparation of detailed business cases.

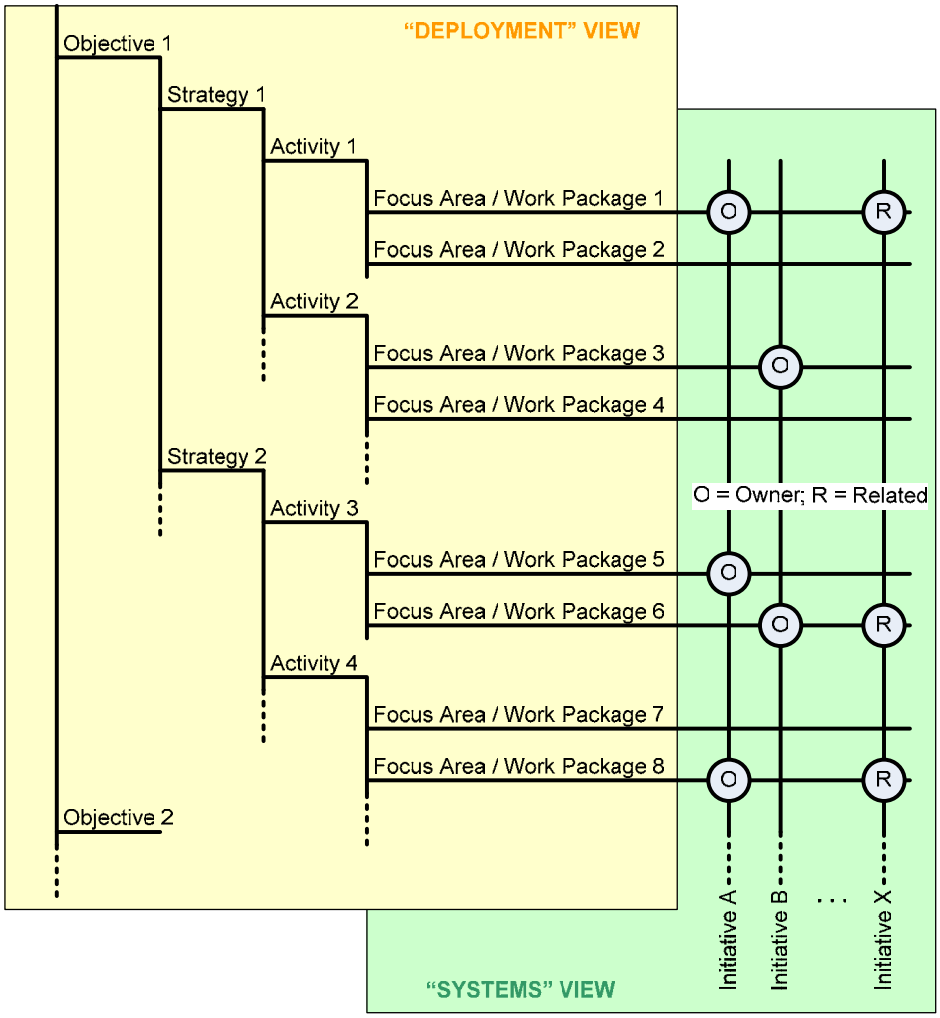

Figure 1 – Organisation of Recommendations

Communication document

The communication document is a compact summary of the recommendations in a double-sided poster format. One side overlays the initiatives on a representation of the ENERGEX network business environment – this gives a rough idea of context and scope for each initiative. The other side depicts the distribution network and communications networks in a (somewhat) physical hierarchy, and roughly describes the impact of the technology plan at each level.

Appendix 3 is a copy of the communication document.

9. Documentation

The following is a guide to documentation produced throughout the technology planning process. Most documentation is held in electronic form.

Summary	
Executive Summary (Project Note 35) and Appendices	This document.
Narrative (Project Note 17)	The "narrative" is walk-through of Phase 2 in conversational style, with illustrations. It should be of interest to readers requiring more information about process and methodology.
Outcomes	
Initiatives documents	There is one such document per initiative, as previously described. Each initiative is uniquely numbered.
Details	
Technology planning database	The technology planning database is the source of the Appendices to the Executive Summary, and of parts of the Initiatives documents.
Project notes	Project notes encapsulate miscellaneous details, methodology notes, etc. in small parcels. Each note is uniquely numbered.
Reference documents	Reference documents are documents created outside the technology planning process, and used within it.
Progress reports	Progress reports delivered to GMNAM and the Network Technical Committee.
Data	Data extracted from NFM, NO and other sources, and analysis results.

10. Conclusion

The production of a strategic technology plan is just the first step in a long process, which to be successful will require significant ongoing commitment. The most common pitfalls will be avoided if -

- Architectural disciplines are embedded into key engineering processes. In essence, this requires:
  (a) Adherence to a systems view centred on long-term objectives, and
  (b) Verification of the evolving architecture through modelling / simulation, peer review, prototypes, field trials, etc.
- Diverse activities to implement the technology plan are professionally managed and coordinated
- Progress against the technology plan is regularly reviewed by senior management
- The technology plan itself is regularly reviewed and updated to reflect prevailing business and technology trends.