Enterprise Agility—Managing Risk with Agility

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Public Service Company of New Mexico (PNM), a medium sized electric and gas merchant utility, provides an excellent case study of agility in *response able* business processes. This case study focuses on the application of agility-enabling principles, and the benefits these principles generate. These same principles can be applied to the design of any enterprise strategy, business process, or system design. The value of the case study is its demonstration of how agility in anything is achieved, and should be viewed with an eye for generalization to other processes that need response-ability. Chris Hickman, executive director of engineering and technology, and Gene Wolf, principal engineer, were kind enough to spend hours reviewing this case.

This case study deals with the design, construction, and maintenance of substations—not normally of detailed interest to CxOs and others outside of the engineering function ... but, fundamentally, this case illuminates proactive risk management in action—which is the value proposition for agility. Of course this is project risk management at a fairly removed level from traditional financial risk management—but the principles are the same.

The purpose of agility is to reduce both risk and vulnerability in a dynamic and uncertain environment. The principal risk is response sufficiency. The principal vulnerability is response predictability.

Vulnerability in substation projects includes total commissioning time, securing construction permits, timely availability of necessary equipment, availability of experienced design resources, budget limitations, total cost, other projects diverting project resources, and timely repair and upgrade. At risk is effective outage response, timely new-service expansion, major-customer new-service satisfaction, performance credibility, and permitting-agency trust.

Benefits In Context—A substation typically takes six months to design before construction begins. Gaining necessary permits and construction typically takes an additional 6-12 months. In contrast, PNM regularly completes design activity in 6-8 hours. As to construction: A major customer requested a new substation, and needed it operational in eight weeks from contract signing. Design, construction permits, construction, and power delivery were completed by PNM in 58 days, on budget, and on schedule. Though eight weeks total is not PNM's usual end-to-end project time, this was not a fluke. It is repeatable, when necessary, and when the situation encourages rapid permitting. Total cost for a completed substation project has been reduced by 25%—principally by reducing engineering time and equipment costs. PNM's design and construction processes have reduced response time and response cost significantly, and made response predictability a non-issue. Construction permits, which are politically location dependent, are the only remaining time uncertainty—but even here, PNM has new response options that can shorten this process in some cases.

PNM averages 6-8 new substation projects a year. A substation takes high voltage power from transmission lines and steps it down for final distribution direct to a major customer, or to some number of pole transformers for residential and small customers. Substations are designed for specific power delivery requirements, which varies among substations depending upon the intended service. Typically each substation is custom designed—which was how PNM did it as well—before their agile process innovation.

Case Study—Ten general principles have been shown to enable high *response ability*. These were discovered in research that analyzed hundreds of systems and processes that exhibited agility[1]. These principles are based on a process response architecture of *reusable* modules *reconfigurable* in a *scalable* framework, and are evident enablers in the PNM case. Briefly, the ten principles are: 1) an evolving framework of standards, 2) encapsulated modularity, 3) facilitated plug compatibility, 4) facilitated module reuse, 5) redundancy and diversity, 6) elastic capacity, 7) distributed control and information, 8) facilitated deferred commitment, 9) non-hierarchical interaction, and 10) self-organization. It is not necessary to employ all ten principles in order to achieve significant agility.

If your agility interest is not in the engineering vein—realize that modules are just the interacting units in any grouping joined in common purpose. They can be the people teamed on a project, the clauses in a contract, the instruments of energy-supply risk management, the IT applications of enterprise infrastructure, the response options for regulatory compliance, the supporting arguments and data for rate approvals, and so on—with the framework facilitating rapid assembly and response.

PNM's basic strategy includes:

1) *Evolving framework of standards*—PNM standardized a sub-station architecture that accommodates almost all needs. This provides the framework for reconfiguration, and includes an embedded infrastructure of conduits, standard conduit physical interfaces, specified space limits for equipment, and standardized concrete pads that can accommodate all transformer and switchgear options. Important for any framework that would support agility are two deeper principles, in purposeful tension: the principle of *requisite variety* insists that a framework must have standards for everything *necessary*, and the principle of *parsimony* insists that a framework must not have any *unnecessary* standards. One too

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many standards will decrease agility. One too few pushes agility toward chaos. When agility is a process goal, the nature of the framework is a most important factor—it both enables and limits agility. Maintaining and improving agility relies on managing framework evolution ... prudently. PNM's substation framework now has three versions. Prudence in this evolution maintained conduit interface standards, important for continued *module reuse*; but added new module options for transmission input configurations and feeder output configurations. The third "fly-through" version changed the perimeter configuration to fit within a transmission line right-of-way; reducing difficulties with permitting and land acquisition. Prudent evolution did not impact the *plug-compatibility* of existing equipment modules.

2) *Encapsulated modularity*—Encapsulated modularity shares most-important-factor status with frameworks. These two principles alone provide basic agility. Without both, *effective* agility is doubtful. PNM's prime module types include transformers, switchgear, transmission termination structures, low-voltage feeder circuits, and station steel. In each module type there are generally a few varieties, allowing configurations customized to a particular substation need. Again, deeper principles of *requisite variety* and *parsimony* insist on sufficient but minimal module variety. Transformer specification is what determines substation delivery capability. PNM found three varieties to be both sufficient and minimal: 16, 22, and 33MVA. The *encapsulated* requirement for modules requires that they be functionally self-sufficient to meet their objective, and that the methods employed for meeting objectives are of no concern to the greater system. Thus, the change from one transmission-input configuration to another has no effect on the rest of the system.

3) *Facilitated plug compatibility*—Plug compatibility simply means that modules can be readily plugged into the framework infrastructure—with no modification to anything. *Facilitated* is the operable word, and has two facets: a standardized plug (or socket) interface specification, and designated responsibility for the presence of the standardized interface on the module. In the general case, someone has designated responsibility for ensuring such interfaces on new modules that become desirable in time. In the substation specific case, PNM has provided an invariant standard interface spec to the transformer manufacture, and the manufacture delivers a plug compatible unit. Regardless of power ratings, hook-up interfaces are all identically located and identically specified, ready to mate with the framework infrastructure and compatible with standardized equipment space allowance. Newer module *methods* may be employed over time, as long as their basic objectives are met and the interfaces remain unchanged. In the case of transformers, should technology evolve, a superior performing version may be substituted without unintended consequences from integration. Minimal module types also reduces spares inventory requirements while increasing the likelihood of a necessary spare on-hand.

4) *Facilitated module reuse*—Reusability of modules is a paramount advantage of agile systems; but again, *facilitated* is the operable word. *Basic* reuse-facilitation comes from *plug compatibility* and *encapsulated modularity*. But beyond that is the need to facilitate design configuration and assembly by ensuring that modules are both *readily reusable* and *ready for reuse*. Note that design has become a configuration and assembly activity, rather than a custom design-from-scratch activity with attendant human-error risk. PNM developed a custom AutoCAD-extension solution they call 3D-DASL, described in a *Transmission & Distribution World* article[2], as their substation design tool—facilitating ready reuse with added built in menus for quick drag-and-drop placement of stored pre-drawn modules, added pre-drawn standard layouts for all drawings, and built-in configuration restrictions that ensure the chosen modules are compatible with the power requirements. The 3D-DASL tool is structured to enforce framework and module standards; reducing the design time from six months to six hours—while reducing risk by eliminating vulnerabilities. Ensuring that modules are ready for reuse is important in construction and operational activities, after design is done. This is accomplished with processes and responsibilities that enable timely acquisition of modules, and ensures module inventory is sufficient and maintained in a state of readiness.

5) *Redundancy and diversity*—Module redundancy means identical proven units are available for reuse—with no surprises or unintended consequences. Module diversity means there are variations within a given module type—offering configuration options for custom needs. A properly designed framework facilitates employment of both redundancy and diversity. Rather than increasing capacity with customized one-off modules, such as a custom designed higher-power transformer, two standard modules could increase power delivery capacity without the risks of new design and first-time equipment. Though PNM has not employed this dormant capability, it is available to them. The three-variety transformer diversity also gives them the ability to mix any two for just the capacity they need. Though not shown in the module list earlier, the greater substation process includes people as working modules, particularly in design engineering. Here we see that diversity among engineers is facilitated—less experience and less training makes available a broader pool of capable engineers when peak needs or retirements require new or additional resources. Redundancy also plays a key role in minimizing inventory costs, while maximizing inventory effectiveness and reducing the risk of prolonged outage.

6) *Elastic capacity*—Effective capacity-demand response is often a prime driver for agile process development, and rears its head when demand doesn't meet expectations. Fixed costs and capital investments often make downsizing uneconomical, while added capability can't be built fast enough. PNM has effective options to accommodate unexpected capacity demand. If demand does not materialize as expected, they can easily replace a larger transformer with a smaller one, and redeploy the larger one where it is more economic. For increased demand they can upgrade the transformer, tap the dormant capability to add an additional transformer, or even add a duplicate substation relatively quickly. On the peopled-side of the equation, peak design demands can employ additional engineers easily. And since the design engineering time has been reduced so dramatically, existing engineers already spend the bulk of their time in other engineering activities—a reduced substation design-load is barely noticeable.

7) *Distributed control and information*—One of the three cornerstones[3] of agility is knowledge management, another is decision-making support. These rely on information and decision control being in the right place at the right time. Effective decisions are made at the point of most knowledge. The most knowledge is available at the point of knowledge application and feedback learning. PNM's transformer and switchgear manufacturer has the most knowledge about unit cost and performance options, and is expected and empowered by PNM to employ what they know to be the best components to achieve objectives.

8) *Facilitated deferred commitment*—In order to avoid rework and waste when a situation changes mid-course, this principle insists on just-in-time decision making, and facilitation of decision-implementation time reduction. PNM's reduction of design time from six months to six hours considerably reduces implementation time and postpones the need for procurement and construction commitments to a bare minimum. Module standardization permits construction to proceed with spares inventory before replacement modules are received. PNM negotiated a collaborative alliance with a single transformer and switchgear manufacturer, which facilitated a shortened procurement cycle by eliminating bid procedures, and facilitated a shortened manufacturing cycle by ordering units identical to previous ones.

9) *Non-hierarchical interaction*—Seeking approvals and sign-offs, and filtering communications through hierarchical silo managers, is both time consuming and knowledge reducing. The alliance with PNM's transformer manufacturer encourages direct engineer-to-engineer collaboration. Standardized ordering and standardized design eliminates both internal and external approval cycles and review sign-offs. Risks of miscommunication and protracted approval cycles are gone.

10) *Self-organization*—Self organization is an advanced principle employing modules that can make decisions and change the nature of their relationships with other modules by themselves. The PNM case offers two self-organizing situations of note. The first involves the construction-permit activity. Trust is a self-organizing factor in relationships, and extremely pivotal in gaining timely construction permits for PNM. Trust develops or deteriorates over time as parties interact and as the parties in a relationship change. A permit agency expects to scrutinizes plans deeply, with a healthy degree of skepticism, often with people who are involved with other priorities and not readily available. PNM accelerates the self-organization of trust with standard plans that have been approved in the past, by delivering finished construction consistent with approved plans, and by reinforcing trust development with a post-construction meeting that reviews pictures showing the pre-construction 3-D elevation computer picture matched to a photograph of completed construction. The second example of self-organization has yet to play out, but is a dormant possibility on the edge of expression. PNM's standardized substation process is being tested at Long Island Power Authority and at Kansas City Power and Light, as of December 2004. PNM's purpose for broadened usage is to develop a community of users, with new and diverse needs, that will collaborate in a self-organizing fashion toward improved functionality.

Concluding Remarks—The PNM case study demonstrates that agility can reduce bottom-line costs—and at the same time, reduce response-sufficiency risk and response-predictability vulnerability. Of course reengineering existing processes and systems for agility does incur some costs, but a far greater cost is incurred with an inefficient and poorly-responsive status quo. When migration toward more agile processes is done incrementally and knowledgeably, extreme ROI can be realized, with short-term bottom-line effect.

The previous article[4] of this series introduced a *response maturity model*. It would be illuminating to assess this PNM case against that model, as it would put their accomplishment in a cultural perspective. Is this case a fluke of accidental nature? Where does PNM's process response fit in the continuum of maturity development: accidental, repeatable, defined, managed, or mastered—and why?. We will look at this next time.

Do you know of an agile process candidate that might make an instructive case study? Contact dove@parshift.com with comments and suggestions.

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