Technical Management is Not Technical Control

or, All I Really Need to Know About System Engineering I Learned From Farmers

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- Biography
  - B.S., Aero/Astro, MIT. M.E., Aerospace, USC.
  - JPL, Deep Space Network since 1990
  - DSN Ranging, Tracking Subsystem Engineering
  - JPL Award for Excellence.
    - For implementation of DSN ranging.
- Fields of Interest
  - Spacecraft Navigation and Tracking

Systems Engineering & Common Sense

- There is a little System Engineering in everything.
  - Strip away the technical details, and good Technical Management looks a lot like common-sense farming.
- Topics:
  - Risk Management, not Risk Control.
  - Thinking long-term, unlike the workers / day laborers.
  - Architecture: knowing what is and is not part of the business.
- Major common theme: You manage without having complete control.
  - A farmer's profit is at the mercy of the weather.
  - A engineering project's success is a probability, not a certainty.
  - Both need to manage risk, and avoid the illusion of control.
  - Both rely on basic practices to deal with complexity and make decisions.

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Risk Is Our Business

- The goal is to ***not be surprised*** by an outcome that was never considered.
- When you can't control the outcome, find bounds on all likely outcomes.
  - Farmers don't control the weather, but they can anticipate the results and plan accordingly.
  - System Engineers make contingency plans from reasonable risk scenarios.
- Common sense tells you to not base your plans only on success.
- Evaluating Risk versus Reward can get lost in the 'gee-whiz' technical features.

Long Term

- Owning the land means considering next year's harvest.
  - Hired labor doesn't care beyond this season (or deliverable).
  - Damaging land or infrastructure for one harvest leads to failure.
  - Tools and tractor purchases are multi-harvest decisions.
- Good System Engineers also think beyond one project.
  - Future projects benefit (or suffer) from the residue of today's.
  - Sometimes, the System Engineer is the only one considering the cradle-to-grave issues of the current project.
    - Developers and Project Managers are paid to get something out the door.
    - The System Engineer is the inspector for 'penny-wise, pound foolish'.
- The long-term view often requires stepping back from the technical details, and thinking in simpler terms.

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Ghosts of Projects Past

- Institutional Memory means knowing where the bodies (and pipes, conduits, old foundations) are buried.
  - The important data are often the low-tech information.
  - Domain experts know what to do, but only if they have the data.
- Farmers see the Past everywhere
  - They know how deep the frost goes, where the snow drifts high.
  - They don't just see a field: they see topsoil depth, old pipelines, hidden rocks. These are things only they can teach their kids.
- The System Engineer is often the source of continuity.
  - They remember the previous mistakes and solutions.
  - The good ones write it down for the next group.

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What Architecture?

- Farmers don't use this term. They just know their business.
  - They know what they can produce and how they do it.
  - Ask a cattle rancher to grow mangos, & she'll show you the door.
- When a System Engineer defines the parts of a project, and how they work together, they call it an architecture.
  - Most System Engineers would envy the clarity of understanding that a Farmer has of their farming business.
  - Understanding the architecture isn't based on technical depth, but on high-level compartmentalization and completeness.
- Both professions need someone deciding what is, *and is not*, part of the business.

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Summary

- Don't let the technical issues obscure the basics:
  - You don't control risk, you evaluate risk and manage the responses to it.
  - The long-term doesn't take care of itself.
  - Know your business, so you don't over-extend your resources.
- Good farmers make a living through good years and bad. Bad ones thrive only on success.
  - System Engineers operate under the same rules, they just have fancier toys.
  - Having lots of technical details and new technologies in a project doesn't make it immune from the common high-level problems.