Elements of Control System Longevity

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“In theory, there is no difference between theory and practice. But in practice, there is.”
—Yogi Berra

“Success comes from experience; but experience comes from failure.”
—Mark Twain
LONG TENURE

• We build controls for '30-year' systems (job security?)
• You will upgrade many times...
• ...and the first one may precede commissioning (job pain!)
• Goal: upgrades are not disruptive
PITFALLS

- Language
  - Avoid fads...the mainstream may not be what you like
- Ditto for the fancy IDE
PITFALLS

• Operating System?
  • Few last as long as your system...
    • ...and an old OS needs old {hardware, people}
  • How many are you supporting?

• Use a ‘glue’ layer for essential services
PITFALLS

- Transport
  - This is your middle-ware ‘backbone’
  - Don’t distort your architecture: map your own concepts (name discovery, congestion control, graceful recovery, etc) to it

- Let it be asynchronous...
PITFALLS

- Hardware and Network
  - The rate of change here has been astounding
  - Plan to mix it up—like ‘crates’ with free-standing ‘smart devices’
    - Is each device its own server?
PITFALLS

• Your shopping list:
  • Hardware
  • OS
  • Language
  • IDE
  • Libraries
  • For all host/target combinations...forever
DECOUPLING

• “Decoupling, decoupling, decoupling.”
• It’s the web of dependencies that get you...
• How far does a change ‘ripple’?
  • Solution: a few layers, and fewer protocols
  • No ‘cheating’ (reaching around)
LAYERS

• Avoid middle layers
  • 'Manager' and 'Supervisor' belong in your org chart, not your architecture
    • Use self-configuring 'gateways' (bridges) to solve simple fan-out issues
  • Re-publish any 'value-added' in same layer
  • A 'flat' system is easy for clients
    • The hierarchy should be in the naming
DECOUPLING

- Pick a 'narrow' protocol/API:
  - Easy to code to
  - Allows clients to be generic ('tools')
  - It rarely changes, thus...
  - Decouples server and client teams
    - They work in parallel
    - They don’t talk much
  - May support multiple versions
DECOUPLING

- Use a text file (sure, XML) between major 'stages', such as RDB and processes
  - Can easily create one (for consumer); can inspect one (from producer)
  - Insulates you from temporary failures, version mismatches, etc
  - Compatible with your code repository
DECENTRALIZATION

- Gives scaling
  - No single-point of failure
  - Graceful degradation without cascading failures
  - No congestion points
  - Supports incremental build-up
- Allows parallel life-cycles for subsystems
ASYNCHRONOUS

• Have you had any deadlocks lately?
  • Very hard to avoid (or recover from) with 3 or more layers of synchronous elements: the cascade effect
  • There are only two kinds of timing values: those that have changed and those that will
  • Non-blocking protocol/API (message passing) avoids this
• Use a call-back for the hand-shake (transaction)
REQUIREMENTS

- Most are implicit, not explicit
- 50:1 worst case
- There are two kinds: those that have changed and those that will change
- Don’t code directly to them:
  - Use (reusable) building blocks
    - Most are nearly universal for all controls
SUMMARY

• Decouple
• Decentralize
• Go ‘flat’
• Use text files
• Go ‘narrow’
• Be asynchronous
CONCLUSION

• “All problems in computer science can be solved by adding one more level of indirection.”

• “But that just creates another problem.”

—David Wheeler