Impact of Spiral Development on Integrating Software and Systems

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Spiral Experience

- It was not possible to obtain permission from specific projects to release project information for this briefing, however, the composite experience with spiral development does provide some useful insights
- The range of project characteristics on which this experience was gained is summarized on the following pages
Spiral Use - Project Characteristics

- Used for internal development efforts as well as customer projects; customers included both commercial and government
- Many project sizes from under 5 KSLOC to over 1 million KSLOC
- COTS SW usage on these projects ranged from just a few packages to many packages
- Many of the projects started with some amount of reused code

Spiral Use - Project Characteristics

- Application domains ranged from non-real-time administrative tools to distributed real-time ground systems to embedded systems
- Many projects deployed interim spiral products for deployed use; some projects drew from successive spirals to populate an evolving family of products with software
- The number of spirals varied from 2 to over 20, but was typically 4 - 10
- The time to complete all of the spirals has varied from 6 months to 10+ years (and some are not yet completed)
Profiles of Spiral Use

- Spiral development was used on some programs on purpose, and inadvertently at first on others (when requirements were discovered/clarified only after use of the result of what in retrospect proved to be the first spiral)
- Team membership varied from small teams of our employees to large teams from multiple companies (even including customer personnel on a few projects)
- Team structure varied from a single small project team to tiers of Integrated Product Teams

Major Spiral Challenges

- Customer and company management expectations did not always match the results spiral development can/did produce
  - 80% solutions from early spirals raised unrealistic expectations about total project time and cost
  - Tension between getting much coverage of Ops Concept (for obtaining stakeholder buy-in) versus solving hard technical problem (to establish technical feasibility early)
- Contractual provisions were not always conducive to effective use of the spiral approach
  - Cooperation between stakeholders needed for effective spiral development often clashed with desire to preserve contractual leverage
Impediments to Success

- Major changes in key personnel in more than one stakeholder, where expectations and (non-contractual) agreements were not passed on effectively
- Risk management which did not address the full range of risks (often for political reasons)
- Movement of capability to later spirals in order to meet schedule targets without replanning the resources allocated to the later spirals
- Changing the success criteria between spirals

Critical Success Factors

- Focus on the business purpose of each activity in the spiral process needs to be very strong, otherwise the risks do not drive "how much is enough", significant risks are pushed later in the system life-cycle and insight into the nature and magnitude of these risks is often lost
- Keep the bureaucracy associated with managing evolving stakeholder life-cycle commitments to a minimum; otherwise, requirements creep, architectural drift and COTS shortfalls and incompatibilities are not discovered until too late
Software/System Integration

- Degree of software/system integration in each spiral varied dramatically; the more successful projects had more integration earlier
  - Minimal integration in early spirals masked hard work not yet done
  - More integration in early spirals was more costly, since integration often had to be redone per spiral
- Integration challenges differ radically on a spiral development from waterfall development
  - Waterfall challenge is order of integration
  - Spiral challenge is how much integration to do

Possible Conclusions

- Realistically priced spiral development often seems more costly, because costs surface earlier
- The combination of a willingness of alter key requirements/success criteria and an unrelenting focus on making the product of each spiral deployable means that a project can often “declare success” and stop before the last spiral
- Relationships between all stakeholders are key to making spiral development success possible, but honest understanding of intentions and constraints is often difficult