Project Management

Ken Stevens

ECE 4900

Credit: This was adapted from Al Davis' CE Senior Project course

Project Management

- Topics
  - Teamwork complications
  - Idea selection
  - Setting scope and objectives
  - The reality of risks
  - Defining success
  - Realistic scheduling
  - Initial design requirements
  - Documentation

Team Projects

- Teamwork – it's more elusive than you think
  - Leadership teams – common in the workplace and the thesis option
    - clear cut leader
      - point of resolution for disputes
      - often sets and articulates strategy
      - workload assignments and monitoring
      - focus is whole project's scope and progress
    - ideally
      - experience, anticipate trouble before it hits
      - lead through difficulty in fair and productive fashion
      - merits respect through ability rather than demands through position
  - Peership teams – likely in 4900/4910
    - NO clear cut leader
      - although one may emerge
      - beware the yes-man underlings!!!
    - must still provide leader contributions

Choosing Teammates

- No single algorithm
  - personality and needs vary
  - “fire in the eyes” test
- This is a year-long collaboration
  - some qualities are apparent for the wish list
    - talent to do (as opposed to talk/pretend) the job
    - dependable
    - honest
      - inform group of problems BEFORE they become critical
    - efficient communicator
      - this is easier if mechanisms are articulated by the group in advance
    - committed to doing the job right
      - genuine enthusiasm for the project is an important marker
    - others?

Team Composition

- Obvious Requirements
  - group skills need to match project requirements
  - may be obvious but reality makes this hard
- The most crucial and hardest part to get right
  - affects everything else
  - the choice is persistent
  - so: take care on this aspect
    - problems are guaranteed
    - make sure they aren’t show stoppers

Team Destroyers

- Lack of open communication
  - should be no difference in what group knows
    - personal design and implementation is encouraged
    - group review, problem solving, moving past stick points, etc.
  - look out for cliques and sub-group formation!!
- Anything that delays clarity
- Anything that takes more time than it should
  - disputes and competition is healthy if they are resolved in a timely manner
    - it’s not a contest
    - individuals don’t win or lose here – the group wins or loses together
    - differences of opinions help evolve the best answer
    - criticize ideas – not people
- Any negative emotion
  - engineers design, philosophers emote
  - disagree and commit

Idea Selection

- Idea & Team = Chicken & Egg
  - the idea needs to be embraced by the team
  - the team skills need to fit the idea
  - it's an ordering problem
- In the end, the idea needs to:
  - be fun and exciting
    - you should all be truly excited to get this system working
  - must have an engineering scope that is commensurate with a full semester project dome by the number of people in the team
- Novelty requirement
  - There isn't one – OK to design something you can buy
    - learning how to make things work is a lot of fun

Idea Pragmatics

- THE important point
  - whatever your proposal is
    - it must be finished, documented, demonstrated
    - on time
- Psychologically
  - if it’s fun you’ll do it AND do it well
  - if it’s drudgery
    - you and the project will suffer
    - don’t go here
- Sample ideas
  - talk to professors from classes you liked
  - discuss with me
  - brainstorm as a class

Scope

- It's a 5 hour aggregate project by definition
  - definition: 5 hours/week in class + 10 hours/week homework
  - not many classroom hours, but meet with me as needed
- Hence
  - Initial scoping sanity check is by level of effort
  - 15 hours honest work × 15 weeks × number of team members
    - or 225 hours per team member
    - DOES include
      - design, test, demonstration and documentation
    - does NOT include
      - parts lead time, etc.
- Planning for the right scope
  - suggests a manpower estimate for all the tasks
  - this means top-level design and planning
    - needs to be done right as soon as possible!!

Scope Problems

- Things we often underestimate
  - how slow we are
  - documentation time
  - debugging and test time
  - time lost due to screw-ups and risks
  - time lost due to people issues
    - hammered by another class
    - hammered by the need to ski
    - hammered by the need to take a break
    - hammered by sales people
    - lesson = plan for people, not robots
  - group communication time
    - regularly scheduled status meetings are a must
      - minimum requirement is once per week
      - results must be documented in a meeting log
    - can be short but MUST be regular

Group Scope

- Project scope $= \sum$ of the components
- Each component
  - ideally gets assigned to one individual
    - group components are allowed but a lead individual needs to be specified
      - distributed responsibility is a great way to plan for failure
      - the buck needs to stop somewhere
- Parallel efforts
  - key to productivity
  - only works when interfaces are articulated, understood, and documented IN ADVANCE
    - and when screw-ups are communicated instantly
- Component-wise design, testing, and combination
  - process should be clear and scope should be doable with a comfortable margin

Setting Objectives

- The specifics of what you will DO
- Keys to success (remember you must finish!!)
  - have a baseline set of objectives
    - what you're sure you can pull off in the allotted time
      - with room to spare
    - something you'll be proud of
      - this is MUCH MORE important than you might think
      - It's the crowning achievement of your undergraduate career
      - future employers/grad schools will place a lot of value on this and so should you
  - add a wish list
    - what you hope you can also pull off
      - if things go smoothly
    - and you're pretty sure you'll knock the socks of the judges
      - Prof Stevens, your mother, your future employer, etc.

Risk Management

- Every project has risks
  - people/parts/design/testing/salesmen/weather. . .
- 1st step in managing risks
  - articulate them (this is required in your proposal)
    - no need to go crazy at this point
      - remember quality engineering is concerned with reality
    - e.g. Joe gets drafted to serve in Iraq (oops...)
    - er: Joe gets abducted by Martians
      - sure it's a risk, but not a plausible one
  - primary plan – plausible avoidance of the risk
  - mitigation plan – what happens when the primary plan fails
    - might be as simple as how the project proceeds without the risky component
    - ideally provides a plan on how to deliver an equivalent or at least adequate substitute

Surprises

- Every project has them
  - the best planned projects articulate them as risks also
- Large group projects
  - have even more surprises
    - more people mean more communication surprises
      - OK, call them misunderstandings or optimizations
    - more personality issues
    - more dependencies
    - bigger scope means more things can go wrong
      - more interfaces
      - more components
      - probably starts to look like Murphy's law

Defining Success

- Key part of the project planning process
  - defining EXACTLY how you know whether the objectives have been met
    - this must be articulated for the system as a whole and for each major component
- Demonstrating a capability
  - requires defining a test and non-subjective way to score the result
    - in reality the test may have several components
    - this is what you'll show on the final demo day
- Subjective evaluation
  - rarely makes sense, so avoid it
  - exceptions exist for every rule
    - e.g. what if your system generates music
      - non-subjectively it will have to make sound
      - subjective as to whether the music is good or not

Success and the Final Demo

- Why is it such a big deal?
  - because it influences your grade
    - OK - this is an operational issue but isn't the point
- The Point:
  - we're in a professional discipline
  - and labor is in an over-supply situation
    - your job could move to India/China/Russia
    - doesn't matter if the situation changes
  - bottom line
    - the best people get good jobs and the average people don't get very impressive choices
  - the most compelling evidence of what you can do with your education
    - is what you have chosen to do and executed as your senior project or thesis
    - NOTE: grad student GPA's are in the who care's column – its all about what you did for your thesis

Scheduling

- Note: this requires experience and skill to do properly
  - normally you'll find this very hard at this early career stage
- What's required?
  - account for EVERY aspect of the project
  - provide a per-man and per-task GANT chart
    - basically a time-line and dependence chart
  - at any given point in the next year you should be able to answer
    - what team member x is going to be doing on day y
    - this may be overkill, but think of it as an idealized target
  - risk factors should be clearly articulated
  - regular meaningful milestones and the test procedures need to be clear
    - slip impact should be easy to determine
    - margin levels should also be relatively clear

Project Aspect

- Team selection & idea articulation clearly needs to happen first
  - and be revised, scoped, and finally frozen once everybody is happy
  - NOTE: your proposal won't be finished yet.
- Then it starts for real
  - initial design flow
  - component identification
    - lesson learned: in the end this part couldn't do what we thought it could
      - result – demoralizing failure to achieve your goals or extra panic to replace the part with the proper one
  - interface design and specification
    - absolutely critical to enable parallel effort
  - initial design specification and schedule
    - includes tasking, testing, milestones, risk assessment, etc.
  - The Bill of Materials (you'll read lots of specs)
    - supplier identification – primary and secondary
    - lead times (everything needs to be in place by Christmas)
  - proposal
    - detailed specification of the above
    - you'll need my approval BEFORE you get the green light to write it

Initial Design

- Proposal contents review
  - abstract of functional objectives
  - top level design
  - tasking
  - interface specification
  - testing plan and process
  - integration models
  - risk analysis
  - schedule
  - Bill of materials

High Level Design Implications

- Implication
  - high level design needs to be done before Thanksgiving
  - creative part can be a lot of fun
    - however, the blue-sky needs to meet reality
    - of proper scope and realizable by you on time
      - both grade and satisfaction will suffer if you can't pull it off
  - HW, SW, & synthesis modules need to be specified
    - need to be clear about what you'll design vs. what you'll acquire
    - the interfaces need clear definition
      - which is why the will be required in the proposal
    - hardware components will need to be understood
      - web time and lots of reading and group discussion are in your future
  - everybody in the group needs to understand this high level design thoroughly!!!

A Note on Help

- Fundamentally
  - this project is about what your team knowledge, creativity, and skill can produce
    - the next stage of your career is watching
  - you get to lead the choice for a change
    - make it both fun and rewarding
- However
  - feel free to learn from outside experts
    - faculty, friends, colleagues, papers, books, etc.
    - make sure these sources are cited in your documentation
      - required now due to academic ethics
      - will be required later by law and professional/corporate ethics
  - BUT make sure the actual design/implementation/thest is done ONLY by the team

Documentation

- Two main documents
  - 4900 – project proposal
    - See “Proposal Writing” presentation
    - KEY concept
      - this starts now and largely evolves
  - 4910 – final project report
    - thorough description of the entire project
      - ideally working repository of decision and status (lab notebook)
      - with format and contents sufficient for publication in conference
      - others should be able to reproduce your work from this document
    - KEY concept
      - this should evolve from your proposal and lab notebook