Project Management

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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 \times 15 \text{ weeks} \times \text{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/theest 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