Standards, Project Management, and OneNote

Standards:

A standard is an established norm that specifies engineering methods, processes, and practices. There may be standards related to your project. Some places to go to look for these are:

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ANSI (American National Standards Institute)

- https://www.ansi.org/
- ANSI is the national coordinator of voluntary standards activities in the U.S. ANSI approves and publishes standards after they are developed by various engineering, industry and professional groups. ANSI is the U.S. representative to the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC). ANSI does not produce standards.

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Code of Federal Regulations (CFR)

- https://www.federalregister.gov/
- The Code of Federal Regulations is the codification of the general and permanent rules published in the Federal Register by the Executive Department and agencies of the Federal Government.

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European Telecommunications Standards Institute (ETSI)

- https://www.etsi.org/standards#Pre-defined%20Collections
- ETSI (European Telecommunications Standards Institute) is an independent, not-for-profit, standardization organization in the field of information and communications. ETSI supports the development and testing of global technical standards for ICT-enabled systems, applications and services.

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International Electrotechnical Commission (IEC)

- https://www.iec.ch/homepage
- The International Electrotechnical Commission (IEC; in French: Commission électrotechnique internationale) is an international standards organization that prepares and publishes international standards for all electrical, electronic and related technologies – collectively known as “electrotechnology”. IEC standards cover a vast range of technologies from power generation, transmission and distribution to home appliances and office equipment, semiconductors, fiber optics, batteries, solar energy, nanotechnology and marine energy as well as many others.

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Institute of Electrical and Electronics Engineers (IEEE)

- https://standards.ieee.org/
- The Institute of Electrical and Electronics Engineers Standards Association (IEEE SA) is an operating unit within IEEE that develops global standards in a broad range of industries, including: power and energy, artificial intelligence systems, internet of things, consumer technology and consumer electronics, biomedical and health care, learning technology, information technology and robotics, telecommunication and home automation, automotive, transportation, home automation, nanotechnology, information assurance, emerging technologies, and many more.

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International Organization for Standardization (ISO)

- https://www.iso.org/home.html
- The International Organization for Standardization (ISO) is an international standard-setting body composed of representatives from various national standards organizations. Founded on 23 February 1947, the organization develops and publishes worldwide technical, industrial and commercial standards. It is headquartered in Geneva, Switzerland and works in 166 countries.

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International Telecommunications Union (ITU)

- https://www.itu.int/en/publications/Pages/default.aspx
- The International Telecommunication Union (ITU) is an international organization that provides global telecommunication standards. ITU-T Recommendations (standards), form the foundations of the information and communications technologies of today.
-

National Institute of Standards and Technology (NIST)

- https://www.nist.gov/
- The International Organization for Standardization (ISO) is an international standard-setting body composed of representatives from various national standards organizations. Founded on 23 February 1947, the organization develops and publishes worldwide technical, industrial and commercial standards. It is headquartered in Geneva, Switzerland and works in 166 countries.
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In homework set #2, each design group is to

- Browse the standards listed above, and
- Note any standards that are relevant to yor project.

Project Management & OneNote

The point behind project management is to increase the odds of your project being successful. This makes project management relevant for Senior Design: ideally everyone should graduate from NDSU on a high-note with a working device and A's in Senior Design 2 and 3.

Project Management looks at how to manage projects. A project is an activity that has

- A start date
- An end date, and
- A specific outcome or deliverable

This describes your Design 2 & 3 project almost perfectly. Likewise, your senior design task is most definitely a project.

Back in Design I, most of the parts of project management were spelled out for you:

- The project charter was one of 12 tasks to choose from,
- The budget was fixed at about $50,
- The work breakdown structure was pretty much defined by the homework sets, and
- The project management technique used was *waterfall,*

In Design II and III, we'll follow the same steps. However, in Design II and III, the projects are much more complex and diverse. Likewise, these steps are not spelled out for you like they were in Design I. Instead, each group will need to define these steps at the start of their projects.

This his essentially what homework sets 2 and 3 are in ECE 403: specify the project charter, the work breakdown structure, and what project management technique you intend to use. Again, the reason for doing this is to increase the odds of your project being successful.

OneNote

Just like you did in Design I, all or your work is to be placed in a OneNote document, with a single document used by each member of your group.

OneNote works really well for Senior design.

- OneNote serves as a diary for each student. All of your work is placed in your OneNote document.
- One note is very versatile. It allows you to input text, photos, videos, Word documents, Excel spreadsheets, etc.
- OneNote makes grading really easy: all the instructors need to do is go to your OneNote document to see what you've completed. (Nothing needs to be submitted on BlackBoard - your OneNote document contains all of your work.)
- OneNote makes revising your grades really easy. If you got 2/10 on a homework set, simply revise and add content to that section on OneNote. Every two weeks, your grades will be updated based upon the current content of your OneNote document. (note: Final deadline for updating your OneNote document is Friday of dead week.)

OneNote also saves you a *lot* of work at the end of the semester. In the past, a 50+ page final report was required in Design II and III. With OneNote, no separate final report is needed: all of your work is already documented in OneNote.

This last point is kind of important. In industry, documenting your work is always a problem. Once your project finishes, in theory you close the project by documenting your work, finish up all final reports, and archiving these documents for later reference. In theory that's how it work. In practice, once a project finishes you have a half-dozen other projects that need your attention. Likewise, the final documentation never happens. That's a recurring problem in industry.

With OneNote, that final report is essentially your OneNote document. Saves you time and provides something to go back to if/when you need information from a previous project.

Project Charter & OneNote

Possibly the most important document in any project is the *project charter*. This document specifies

- What are the deliverables for the project
- What are the key elements for the project
- How much time is allocated for the project, and
- What's the budget

The part of homework #2 asks you to specify the project charter. Later on, if you're wondering if something is or isn't relevant to your project, refer back to the project charter. In homework set #2, set up a section in your group's OneNote document which specifies this.

Section	Pages	Content
Contact Information	Contact Information	phone & email addresses
HW2: Project Charter	Project Description	*short description*
	Project Charter	*What are the deliverables?* *What are the key elements?* *Time allocated (two semesters)* *Budget (usually $300)*
	Biweekly Meeting Dates	*when you group meets with sponsor*
	Relevant Standards	*Search for and include references to relevant standards*
	Work Breakdown Structure	*Major Activities (level 3)* *Tasks (level 4)*

Homework #2: Create a OneNote document and include a section for your Project Charter

Work Breakdown Structure

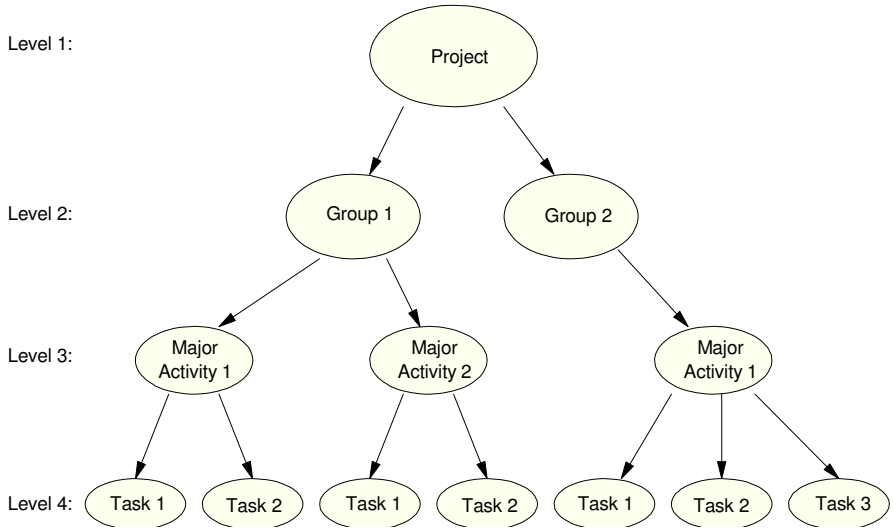
Once the project is defined, the next task is to split the project into smaller tasks - sort of a divide and conquer technique. Once the tasks are small enough, you can start knocking them off one by one.

Level 1: The project as defined by the *project charter*.

Level 2: Split the project by department (engineering, marketing, production) or by functionality (user interface, sensors, filters, etc.) . In Senior Design, the projects are usually small enough there is no need to split the project at level 2.

Level 3: Specify the major parts of each part. For Senior Design, I like to think of this as the major technical challenges you need to solve in ECE 403 so that you'll have a working device at the end of ECE 405.

Level 4: Tasks. What are the tasks that need to be completed to solve each of the technical challenges defined in Level 3.



Work Breakdown Structure: Use a divide and conquer approach to split a project into smaller sections, eventually defining the tasks that need to be completed to finish the project

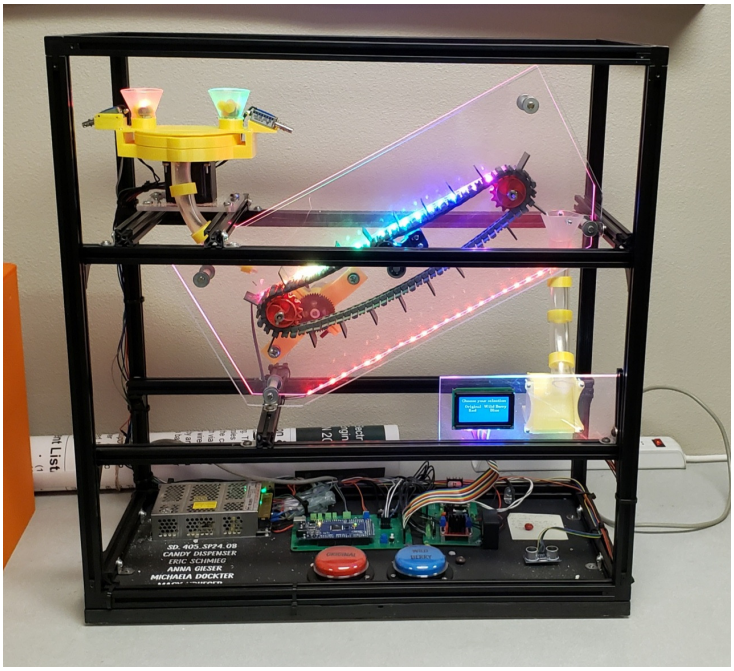
Level 3) Major Activities: The goal at this stage (homework set #2) is to come up with an exhaustive list of tasks that need to be completed in order for your project to be successful. Sometimes, it helps to think about the major technical challenges for a project.

For example, if you look at the Candy Dispenser displayed in the ECE building, some of the major technical challenges could be grouped as:

- Sensors: Detecting inputs
- Actuators: Driving motors, lights, displays
- Packaging: Making a frame that's sturdy and portable

Another way to split up the challenges could be

- Software: Reading the sensors & driving the actuators through code
- Hardware: Circuits for motors, lights, displays, sensors
- Mechanical: Making a frame that's sturdy and portable



Sample Project: Candy Dispenser. Press a button and candy is eventually transported from the upper left to the bottom right side.

Level 4) Tasks: This is really what you want: a list of tasks. This list of tasks is *really* important

- This list defines your to-do list for Design II and III.
- This list is what you'll use in homework set #3 when you splits the tasks among members of your group.
- This list is what you'll work on for the rest of Design II: start knocking off tasks one by one.
- This list is pretty much what will determine your grade in Design II.

Likewise, the last part of homework set #2 is probably the most important homework set of the entire semester.

Section	Pages	Content
HW2: Project Charter	Project Description	*short description*
	Project Charter	*What are the deliverables?* *What are the key elements?* *Time allocated (two semesters)* *Budget (usually $300)*
	Biweekly Meeting Dates	*when you group meets with sponsor*
	Relevant Standards	*Search for and include references to relevant standards*
	Work Breakdown Structure	Major Activities (level 3) ***Tasks (level 4)***

Probably the most important homework assignment is HW2: Tasks

For example, a list of tasks (to-do list) for the candy dispenser could include the following:

Sensors:

- Button: Detect when a button is pressed (regular or tropical fruit skittles)
- Optical Sensor: Detect when a candy drops through a chute, stopping the conveyor belt
- Range Sensor: Detect when your hand is under the dispenser.

Actuators

- Lights: Make the lights move, following the candy
- Solenoid: Drive a solenoid so that it taps the candy three times
- DC Servo Motor: Rotate the selector either left (regular) or right (tropical fruit)
- Stepper Motor: Drive a stepper motor to drive the conveyor belt

Software:

- Select a microntroller which is capable of reading the sensors and driving the actuators
- Select a programming language that everyone can live with

Packaging

- Layout of the Candy Dispenser
- How to make parts with a 3d printer
- Making the part for the candy selector
- Making the part for the conveyor belt
- Making the part for the candy dispenser
- Overall frame so the Candy Dispenser is portable and fairly sturdy

Later on (homework #3), these tasks will be split among members of your group. For now, just try to come up with as complete of a list as you can.

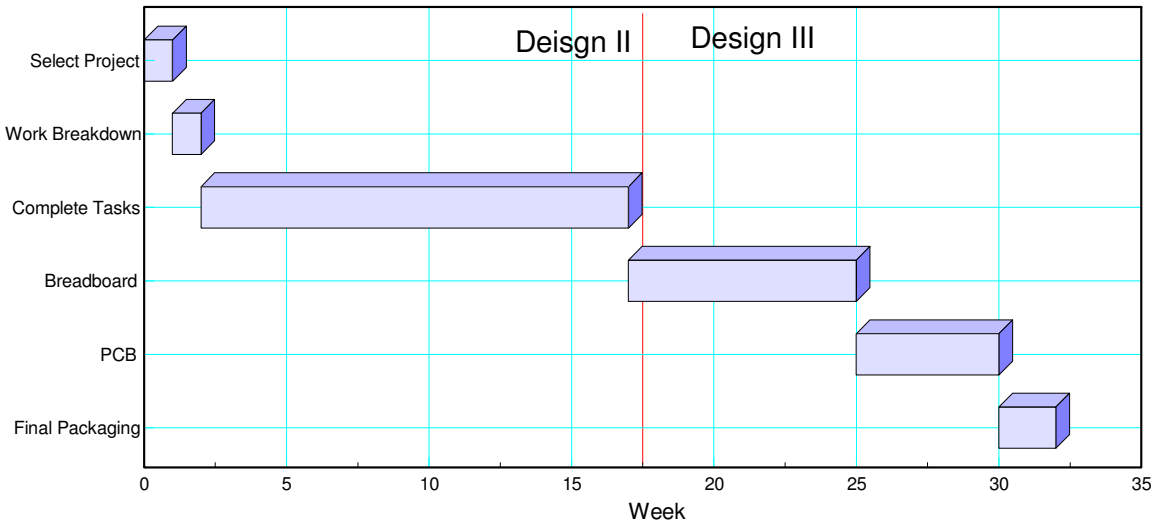
Gantt Chart

Finally, once the major tasks to complete a project are defined, you can start defining

- how much time is allocated to each task,
- what the start date of each task is to be, and
- when the end date of each task is.

In Design II and III, the Gantt Chart is pretty much defined for you by the start and end of each semester:

- Design II:
  - Select a project
  - Define the Work Breakdown Structure
  - Complete tasks one by one
- Design III
  - Take separate designs from Design II and incorporate them into a single working device at the breadboard level
  - Verify and validate your design works at the breadboard level
  - Transfer your schematics to a PCB. Create a PCB to match your working breadboard design
  - Built, test, and validate your PCB
  - Packing your final working device



A more detailed Gantt chart for each student will be covered in Homework #3.

Project Management Techniques

There are many different techniques available for managing a project. Four that were described in Design I were:

- Critical Path
- Waterfall
- Agile
- Total Quality Management

Back in Design I, all projects used *waterfall*. In Design II and III, each group is free to use whatever techniques works best for their particular project and tastes.

Waterfall

The idea behind *Waterfall* is

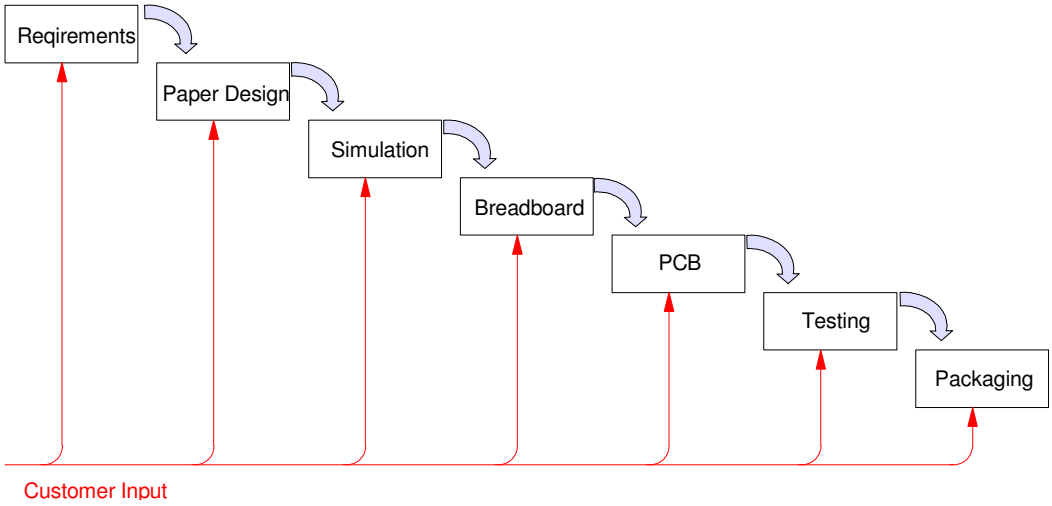
- A given project can usually be split into a set of tasks that need to be completed.
- One way to complete the overall project is to complete these tasks one at a time.
- The *waterfall* shows you the order in which these tasks will be completed.

Waterfall is very common and it's what we usually use in Senior Design. In both 401 and 403/405, a list of things that need to be completed by the end of the course is

- Requirements Capture: Define the inputs, outputs, and how they relate.
- Paper Design: Analysis and calculations for circuits and/or programs which meet these requirements.
- Simulation: Test your hardware design in simulation or test your software with test programs.
- Breadboard: If your design works in simulation, build it on a breadboard to get the schematics correct.
- PCB: Transfer your breadboard design to a printed circuit board.
- Testing: Check that final design meets the system requirements.
- Packaging: Place your final design in a package for delivery to your customer (ECE 405 only).

The is also the order which these tasks need to be done. A *waterfall* approach to project management would have you

- Complete task #1 (requirements) before you start with the paper design.
- Complete task #2 (paper design) before you start with simulation,
- etc.



Waterfall: The project is divided in to smaller tasks.
Each task needs to be completed before the next task is begun.

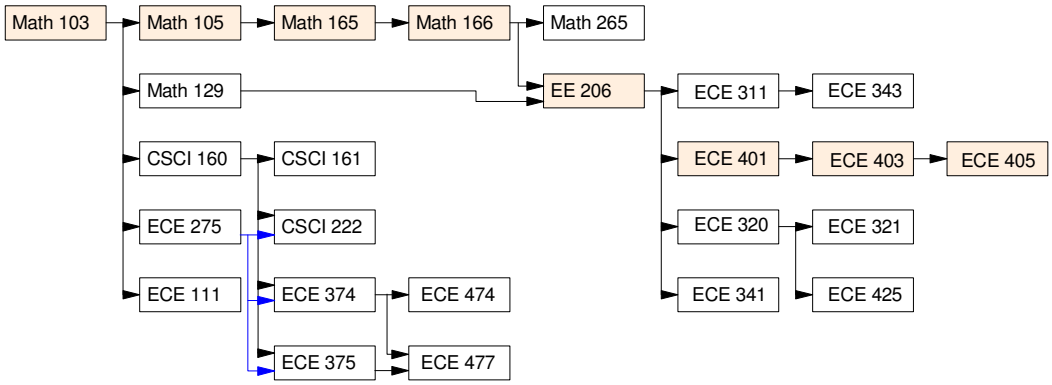
Waterfall projects can be very agile and responsive to customer input. There is nothing stopping you from having customer input and alterations to the design along the way. Often times, this is necessary: customers often times don't know what they want until they see it. As the customer sees your project progress, he/she may get a better understanding of what they really need and what can be delivered.

Critical Path

The idea behind Critical Path is that

- Most projects can be broken down into smaller parts. To graduate from NDSU in Computer Engineering, for example, you need to take and complete forty courses.
- Some things have to be done sequentially. You can't shingle a roof until you have a roof. You can't take Calculus II until you complete Calculus I.
- If you lay out all of the tasks in the order of when they can be completed, you'll see the longest path from start to finish, This is the critical path.

For example, if you lay out all of the courses you need to take in Computer Engineering at NDSU in terms of prerequisites, the flow chart looks like the following. The longest path from start to finish is then evident: the shaded path that starts from Math 103 and ends with ECE 405. That is the critical path.



Courses Required to Graduate in Computer Engineering
along with the critical path (highlighted)

What the critical path tells you is

- If you want to graduate in the minimum time possible, you *need* to be taking the next course in this sequence each semester. If you skip a semester, you postpone graduating.
- The other courses can be moved around to even out the workload each semester - providing you are abiding by the prerequisites.

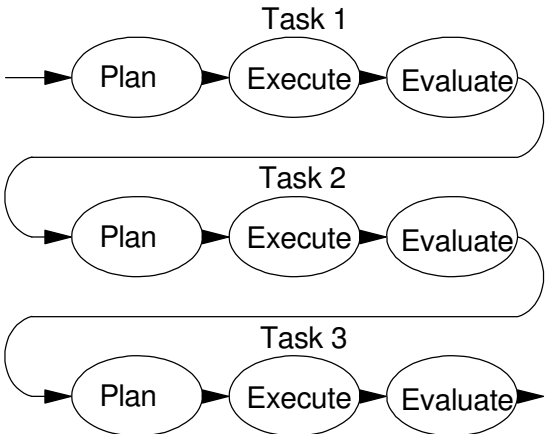
The same holds in Senior Design. If you break your project down into smaller chunks then arrange these by the order they need to be completed, you'll see which activities form the critical path. At any given time, you need to be working on the next item in this path. If you don't, your end date will slip.

Agile

Agile is a slightly different technique than Waterfall. With Agile, you have an iterative design with multiple sub-tasks. The idea is to

- Split the project into smaller tasks, then
- Go through the entire design sequence for each task, one by one (requirements, paper design, breadboard, PCB design, validation)

Essentially, the goal is to slap out a prototype quickly, then iterate on improving this prototype over and over.



Agile: Go through the design cycle multiple times, improving the design each iteration.

For example, suppose you want to build a stoplight. One way to split up the tasks are

- Physical Design
- User Interface
- Traffic Sensors
- etc.

The first iteration might look at the user interface: design a cell phone app that shows you what the stoplight is doing and allowing you to adjust parameters. To get this to work, you could use dummy data. You then get feedback from everyone (customer, software, hardware) that this part of the design is acceptable.

Once done, you could start working on the physical stoplight - having the lights controlled as per the user interface design in step 1. Again, you go through the entire design process for this stage.

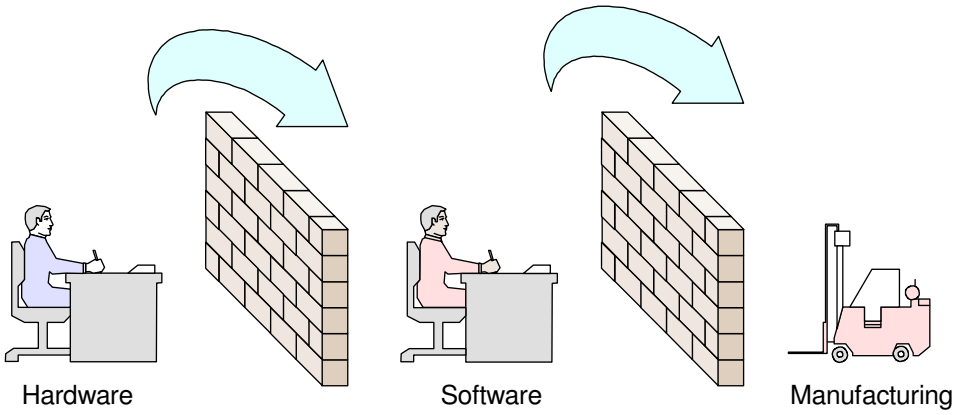
Once done, you could start working on the wireless interface - removing the wires in step #2. And so on.

Total Quality Management (TQM)

One problem which is actually fairly common in industry comes from 'over the wall' design. For example, suppose Company A is trying to design and build a widget.

- The hardware group starts with the design. When done, it passes their final design over the wall to the software group.
- Software looks at the hardware design and it doesn't really work for them. So, software redesigns the hardware and then writes the corresponding software. Once done, they pass the final design over the wall to manufacturing.
- Manufacturing looks at the design and it really doesn't work for them either. So, manufacturing redesigns the hardware and software so that the product can be built.

While this approach works, it is expensive both in terms of time to complete and manpower resources required.



"Over the Wall" design: Once one group finishes their design, it's tosses "over the wall" to the next group, never to be seen again.

The idea behind TQM is to get the design right, right from the start. To do that, you need to have an initial design meeting with everyone right from the start. Once you hash out a framework that hardware, software, and manufacturing can live with, *then* you start the design process.

The hope is that you won't have to redesign the widget each step of the way, saving both time and money.

ECE 403: Homework for Week #2

Set up a OneNote document for your group

- One document per group
- Label it SD403_XX_YY where XX is the semester, YY is your group number

Set up the sections as

- Contact List
- HW2: Project Charter
- Student A
- Student B
- Student C

Loop though engineering standards to find ones that are relevant to your project

- Note which standards you searched and
- Describe the standard and how it relates to your project (if any found)

Brainstorm and come up with a list of tasks that need to be completed

- Fill in

Fill in sections #1 and #2 of your OneNote document

Share your document with each member and the instructors

Section	Pages	Content
Contact List	Contact Information	Student A: Phone & email Student B: Phone & email Student C: Phone & email Sponsor: Phone & email
HW2: Project Charter	Project Description	*short description*
	Project Charter	*What are the deliverables?* *What are the key elements?* *Time allocated (two semesters)* *Budget (usually $300)*
	Biweekly Meeting Dates	*when you group meets with sponsor*
	Relevant Standards	*Search for and include references to relevant standards*
	Work Breakdown Structure	Major Activities (level 3) Tasks (level 4)
Student A	*filled in by each student in upcoming homework sets*	
Student B	*ditto*	
Student C	*ditto*	