Defining Technology

ENCS 393– Social and Ethical Dimensions of ICTs

Day 2 – May 6, 2020

Today's Class

- Defining Technology: working through Nightingale's paper

- Mini-Assignment #1

- Introduction to Reflection Essays

- Reading Hints for Next Class

Nightingale, "What is Technology? Six Definitions and Two Pathologies"

- Who?
- What?
- When?
- Where?

Nightingale, "What is Technology?"

Who?
- Who is the author?
- Who is the audience?
- Who are the subjects?

Nightingale, "What is Technology?"

What?
- What is the subject matter? What is technology: Six definition, two pathology   we should not consider
- What is the medium, or genre? 11:57 It is a research paper   that written in particular paper series, it is an academic publication, but not published in a book
- What style is it written in? 13:17 academic style

Nightingale, "What is Technology?"

When?
- When did the author write the text?
- When do the events/story take place?
- What is important to understand about this?

Nightingale, "What is Technology?"

Where?
- Where was it written/published?
- Where do the events/story take place?
- What is important to understand about this?

Breaking Down the Argument

17.36

- Introduction lot of people think of technology in different ways,but there are not much work trying to synthesize   to make a larger point of defining technology
- Empirical Features 21.48   something we know because we done it   lab based experiment   technology
- Theory: The Nature of Technology the difference between science and technology
- Theory II: The Direction Argument
  - Unknown End Results and Scientific Explanations
  - Unknown Starting Conditions and Operational Principles
  - Tacit Knowledge and Operational Principles
  - Redesign Cycles
- Modern Science and Modern Industry in modern world, the difference may not apply,
  - Models
  - The Division of Labour and Modern Industry
  - System Leverage: Momentum and Lock-In
- Discussion and Conclusion   6   2

Empirical Features of Technology

1. Recent appearance
2. Changing meaning
3. Not applied science
4. Tacit knowledge

The word "Technology" is relatively new

ELEMENTS
OF
TECHNOLOGY,
TAKEN CHIEFLY FROM
A COURSE OF LECTURES
DELIVERED
AT CAMBRIDGE,
ON THE
APPLICATION OF THE SCIENCES
TO THE
USEFUL ARTS.
NOW PUBLISHED
FOR THE USE OF SEMINARIES AND STUDENTS.

BY JACOB BIGELOW, M. D.

BOSTON,
HILLIARD, GRAY, LITTLE, AND WILKINS.
1829.

17

not something that was widespread

it's not a word we used frequently

second half of 19th century, people really start to use this word
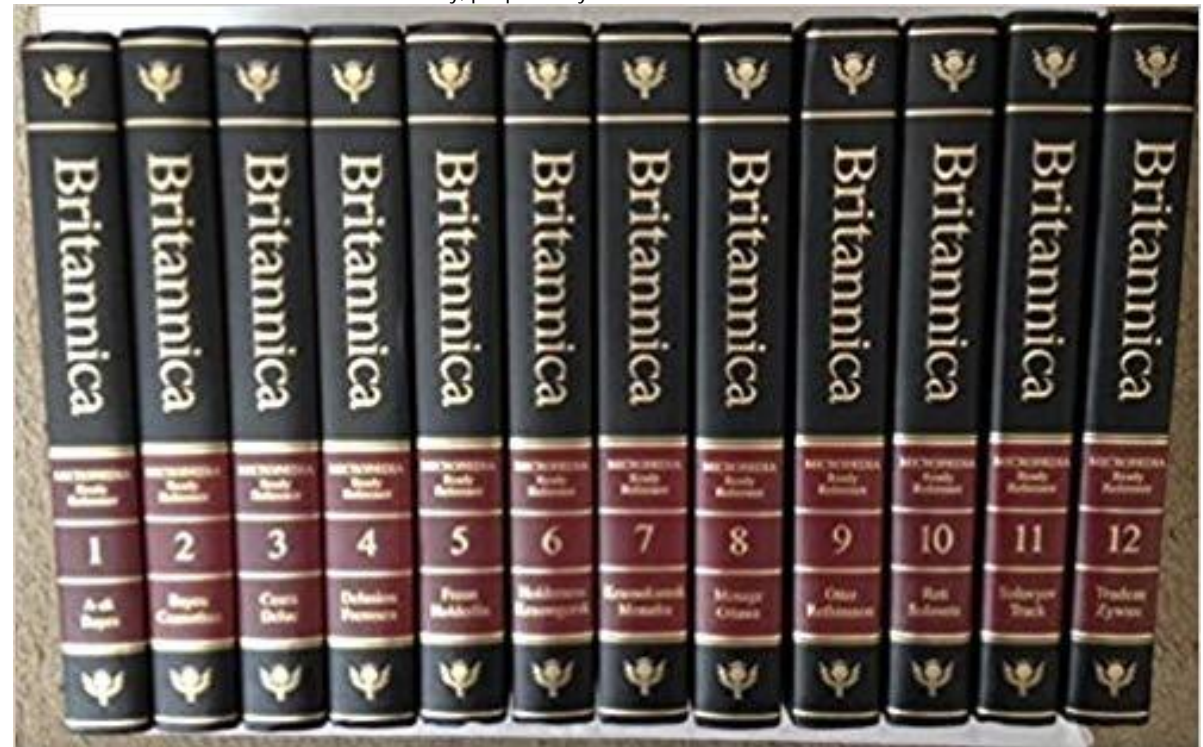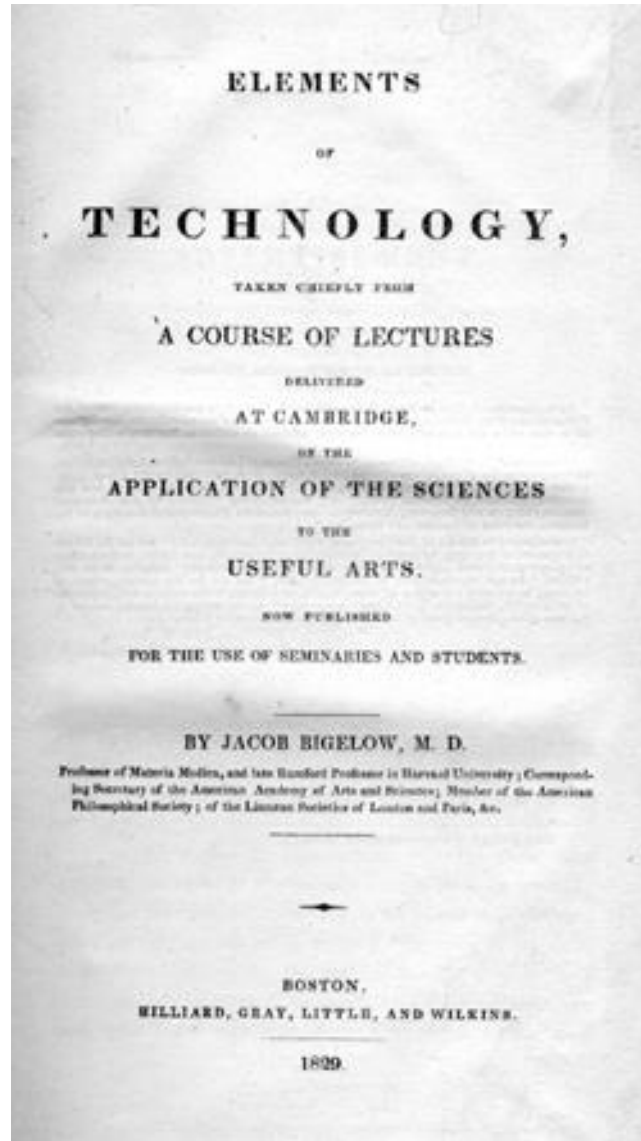
The meaning of "Technology" has evolved

greek, technique ,   engineering,technique skills in art,

17   a guide of doing craft, a guide to particular skill
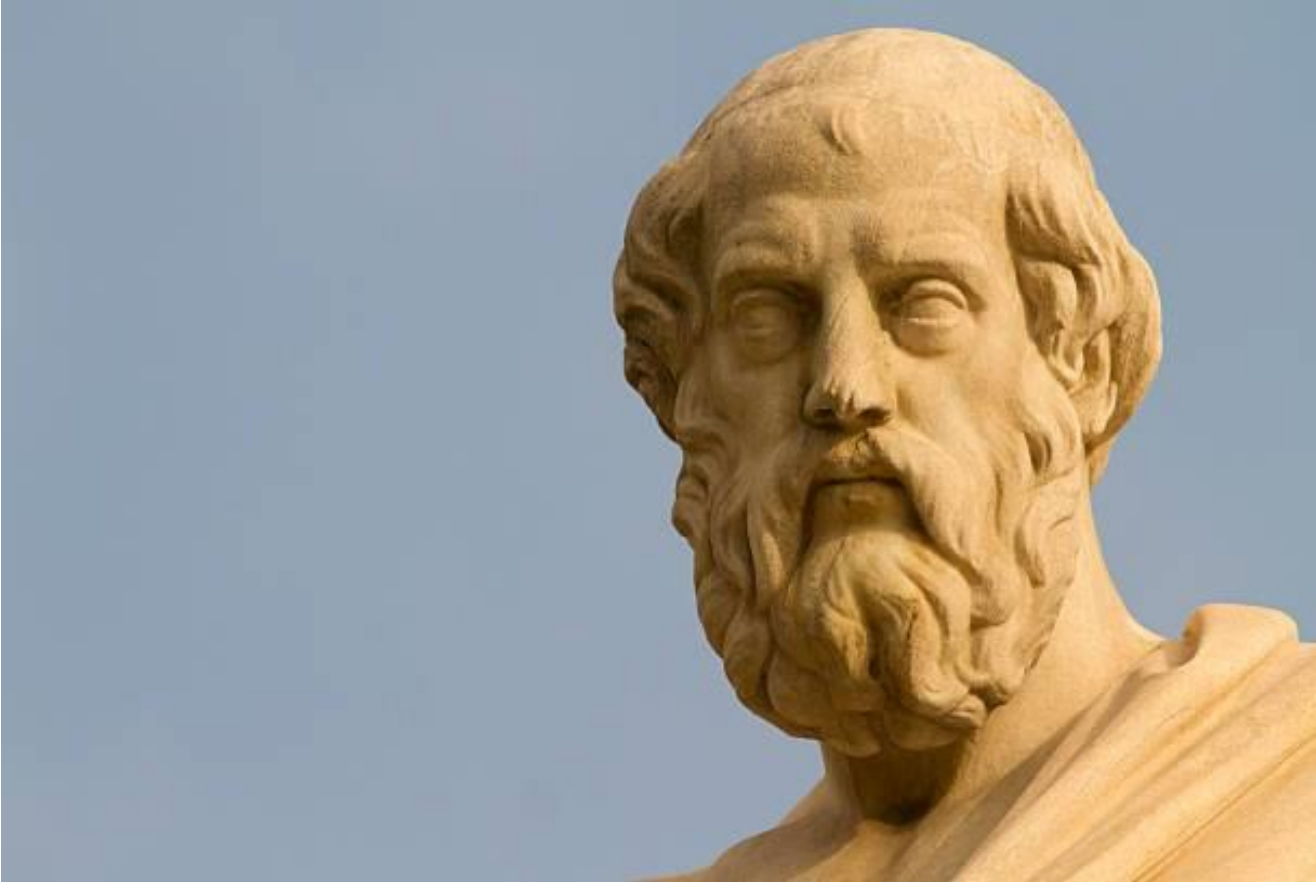
MAKE A
STAINED GLASS
KALEIDOSCOPE
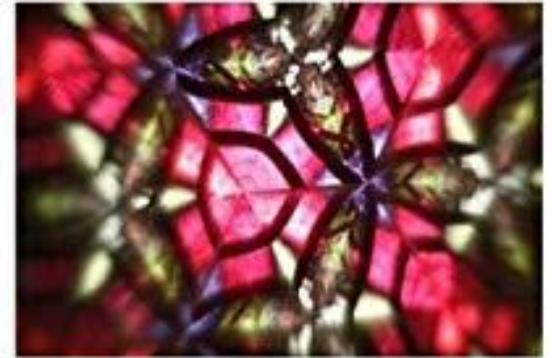
THE STAINED GLASS HOW TO SERIES

SUE SPIRE

Technology != Applied Science

technology   technology   applie science

technology,   scientific knowledge   a process of expreimenting,tinkering   technology

science,   steam engine and air plane

science

technology does not necessarily come from applied science,it does sometimes,but not always

Fig. 91. Locomotive à grande vitesse : type Crampton.
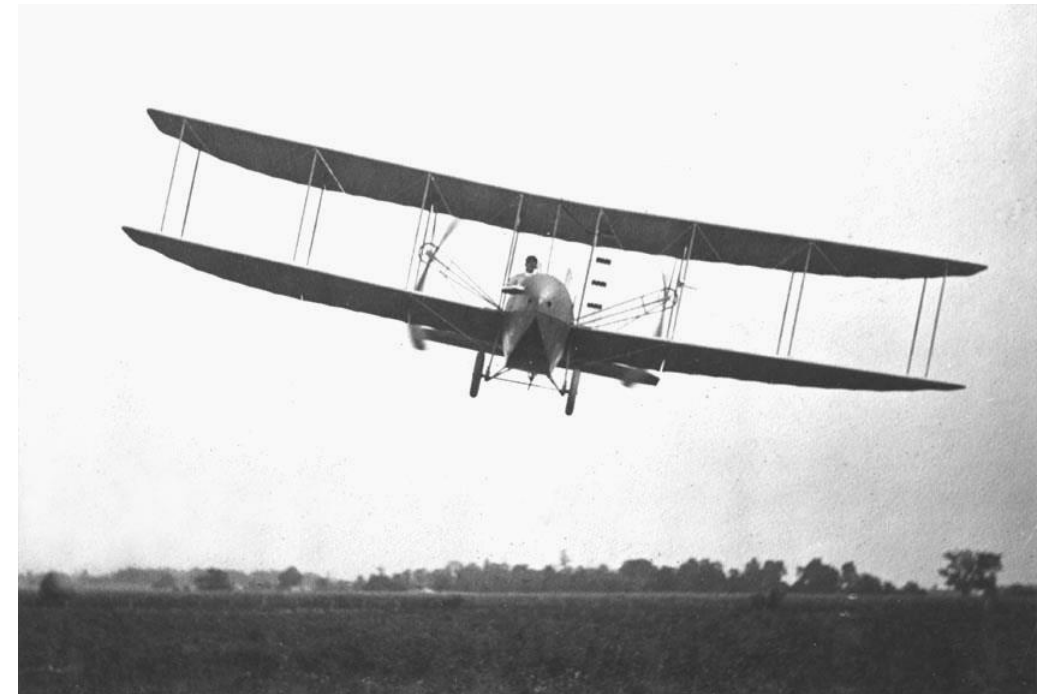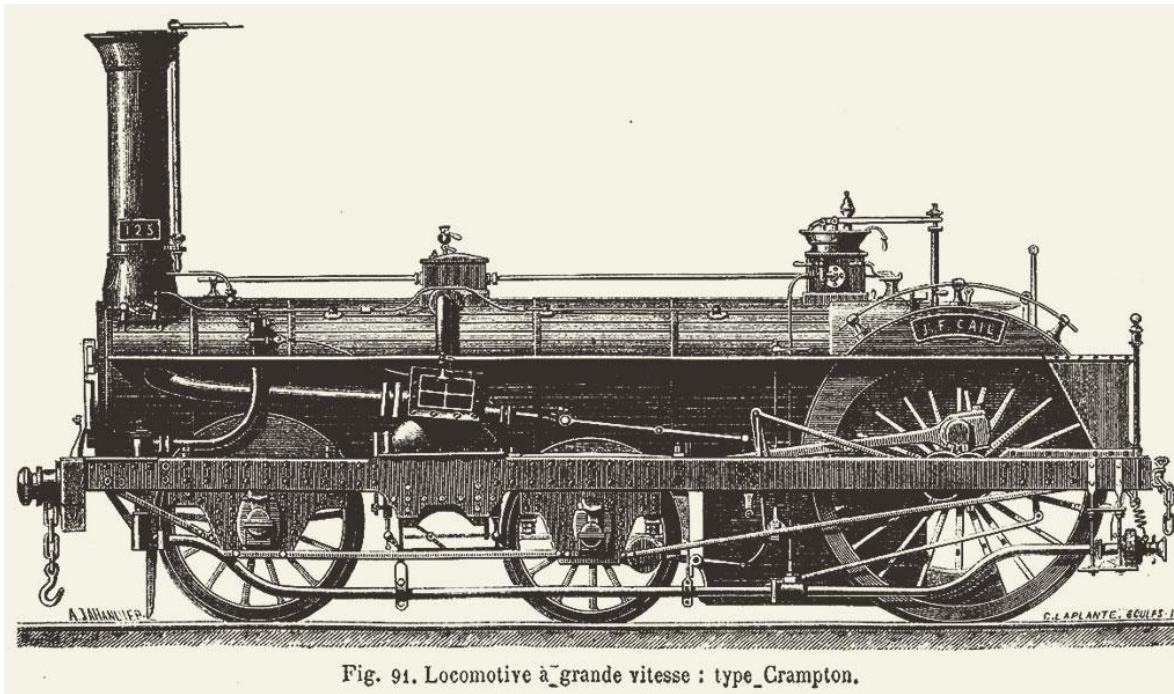
Technological knowledge is *tacit*

technological knowledge is not someone has told us directly or something we read in the book. It's knowledge that we have through our experience

42.30

The Nature of Technology

science and technology,
technology are meant to generate functions, they are not meant to be true or false.   technology   appropriate/inappropriate   technology ,right for the given situation or wrong for given situation
Science are meant to be objective   true or false, right or wrong

it's impossible for us to say the technology is good or bad without knowing about the reason it 's being used or the

shoe   tech

"Technologies…are meant to generate functions. They either function or malfunction depending on how their real world behaviour matches our preconceived ideas about how they should behave."

world to mind:scientific knowledge   knowledge, we observing something about the world then get scientific knowledge, we label some fact
mind to world:technology:changing the world in order to match our need,   technology
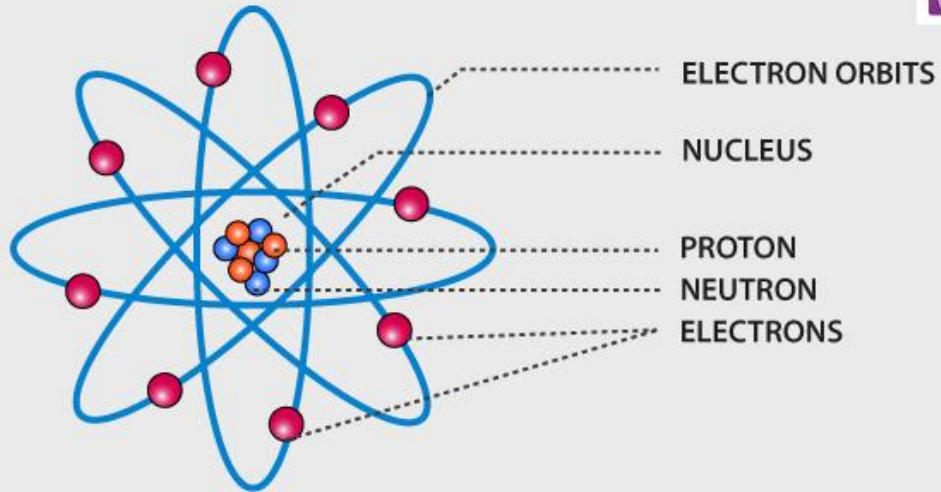
Nightingale's First Two Definitions

entity   produce function

A technology is something that produce a function that it wouldn't occur naturally

2   entity   artificial   produce function,   function   function
byproduct

man-made

Definition 1: Technologies are entities that produce artificial functions

physical object,   process,   algorithm   technology   artificial function

Definition 2: Technologies are entities produced by a problem-solving process that changes and transforms the world so that it matches a preconceived idea, or plan, or design to generate a desired artificial function

Definition2   idea,   plan, technology   intention   ,something help us achieve a goal
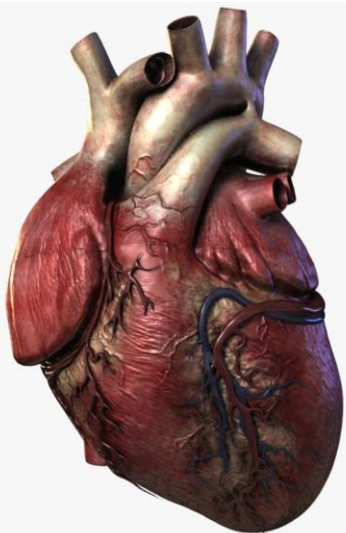
6   definition
Definition1
definition1

technology server different purpose
for different people

Nightingale's Next Two Definitions

technology   infrastructural order   around them

technology   intended purpose   othjer technology,policies,regulations...   operate   technology(   )

Definition 3: Technologies are comprised of artifacts, that generate artificial functions, techniques, and the wider institutional regime required for them to operate.

59.45

Definition 4: Technology is the outcome of a distributed co-evolutionary process in which functions, knowledge, artifacts and their environment mutually adapt to each other.

Technology can be changed over time

People can put technologies to new use that are not the ones that they were designed for

technology can change   adapt environment. technology
                                            co-evolutionary.
            use technology in another way
      technology mutually adapt to each other

technology   science   technology design

Unknown End Results vs. Unknown Starting Conditions

when we start science process, we know what our starting conditions are, but we don't know what our end result is going to be

when we start technology process ,we start to think what we can do to adapt the world to fit our needs,but we don't
know what starting conditions we need in order to get there.

"What set of initially unknown starting conditions will generate a known desired outcome?"
Nightingale claims that this is the type of question that interests technologists.

"Technology is produced by making *value infused choices* about the *operational principles*
that define the basic way in which the technology works." (emphasis added)

people who make technologies using operational principle.When we need
design that technology. The first choice we have to make is the type of
operational principle that will define the basic way in which technology works
                                    entity

How Does Technological Design Happen?

Nightingale argues that technological design processes involve a hierarchy of operational principles, and a series of redesign cycles that adjust these principles.
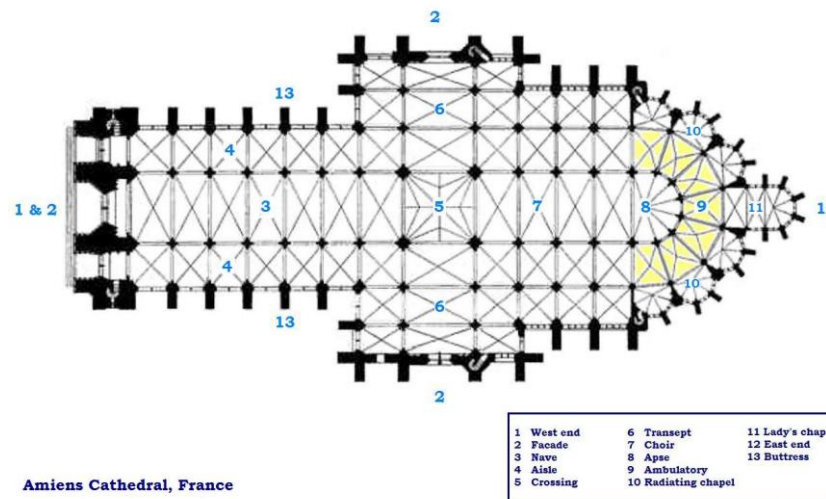
An early key design decision is to establish how innovative an initial design will be.

so then   argues that design processes for technology involved a kind of hierarchy of operational principles. We have to make these operational principle choices at different stages throughout the process for different parts of the design. And then it's about what he calls redesigned cycles. Making a choice, testing it, building it, seeing how well it works, and then adjusting things, adjusting our operational principles, if we need to, adjusting our approach, designing, testing, producing again, and then repeating that entire processes until we end up with something that we are relatively happy with. So here's where he moves from his theoretical discussion to his kind of big historical narrative. Because he says basically technological design has always happened this way. Always happen through choices about operational principles and then redesign. But within that, within that process, the process of technological design has changed in significant ways over the years. So there's a historical story here. There is a change over time, but has to do with technological design that is important for us to consider. And that will eventually bring night yield to his last two definitions. So he's saying that he's making a general points about this idea of redesigned cycles and choices and values and operational principles. But within that general structure for how technological design works, there have been some historical shifts.

technology design

How Does Technological Design Happen?

1. Artisan production (design, production, and testing all at once) 🗨
2. Shift from artisan production to engineering through visual plans (separating design from testing and production) 🗨
3. Shift to modern engineering through use of models (separating design, testing, and production from each other) 🗨

Amiens Cathedral, France

1 West end	6 Transept	11 Lady's chapel
2 Facade	7 Choir	12 East end
3 Nave	8 Apse	13 Buttress
4 Aisle	9 Ambulatory	
5 Crossing	10 Radiating chapel	
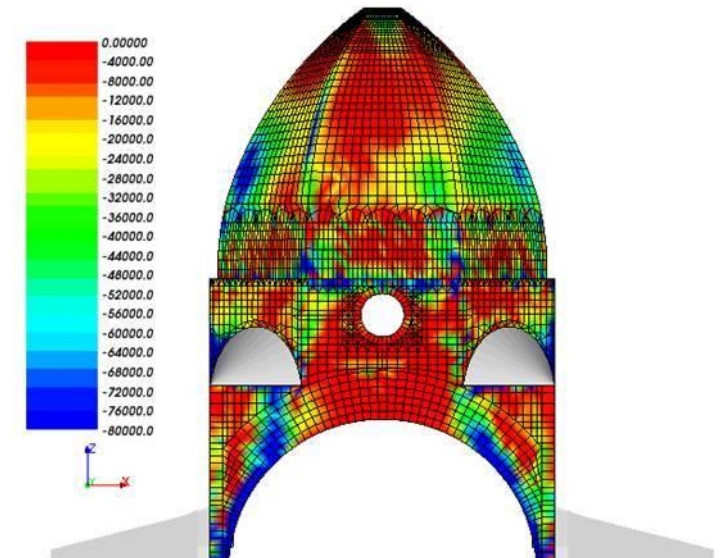
Fifth Definition: Consequences of Modern Design

Definition 5: Technology is all knowledge, concepts, experimental processes, tangible and intangible artifacts and wider socio-technical systems that are required to recognize technical problems and to conceptualise, formulate, research, develop, test, apply, diffuse, and maintain effective solutions to those problems as they change through time.

we can think of the iPhone as a technology, even though we know that there are many iterations of this thing that had existed. There are older iPhones and there are newer iPhones, and they all belong to this category. The newer ones have been modified as a result of sort of testing and use and further development that went on with the, with the earlier models, right? It's all still one technology. And in this sense, Thinking about it.

It's all the same basic thing. It has the same intended function. It has the same sort of form at a very basic sense, but it is now a part of this long-term extended process of redesign cycles where things are being tested and new iterations are being proposed even as kinda completed technologies are out there and existing and being use

his first four definitions are more or less independent of history. His first four definitions can apply to any technology at any point in time. His fifth sixth definitions are more located on a more historically specific. So definition five applies to anything that has been created under this kind of modern design process where we can separate out testing from design and production

Modern Science and Modern Industry

How do science and technology interact today?

1. Improvements in science help us to better understand technological phenomena
2. Better purification technologies can bring "real-world" processes closer to lab processes
3. Models and modeling processes bring science and technology together and deepen understanding
4. Division of labour has changed industrial processes and allowed technology to advance, leading to a **systems-based** understanding of technology

it's historically situate

Sixth Definition: Considering Modern Industry

, what he tries to do with definition six is He's defining a systems approach

Definition 6: Technology covers the artifacts, systems, knowledge, and activities associated with the development, production, and use of artificial functions that have been developed *after* the conditions were in place for science and industrial production to converge and production to move from machinery to systems.

So moving away from individual artifacts, even moving away from kind of different instances of a particular type of artifacts to talking about an entire industrial technological system

nuclear power plant technology under this definition that exist in modern industry and represents this kind of move away from individualized pieces of machinery to a larger system

So basically his fifth definition is talking about the ability for sort of one technology to span multiple iterations and to describe a process of like a long-term process of change over time. Six definition is talking about technology as a larger system. So beyond this one thing or one group of the same type of things to a larger set of interconnected.

These fifth six ones are the result of this entire kind of discussion that He's given us about, about redesigned cycles and changes in the technological design process and interactions between modern science and modern technology.

Technological Momentum and Lock-In

Summing Up: Six Definitions

Technology is…

1. …an entity that produces an artificial function
2. …the specific, intended outcome of a problem-solving process
3. …a combination of artifacts, technique, and regimes/larger structures
4. …the outcome of a process where all of the above things co-evolve
5. …not only the specific outcome of a process, but also the continued evolution of artifacts, techniques, and structures over time
6. …the continued evolution of large technical systems, made possible by the convergence of science and industrial production

Warning! Two Pathologies

Nightingale also warns us about two things that technology is NOT…

He warns us that technology is not just gadgets. And by that he means technologies, not just the material thing that we should not think about. The things that they be, the effects that technology has, the function that it produces. You shouldn't think of that as a result of what he calls the intrinsic physics of the thing. So it's not all about material,

1. …just gadgets (i.e. just material things, their "intrinsic physics")
2. …just how things are (i.e. inevitable, separate from their contexts)

It's about sort of this intentional design process that involves his value-laden decisions about how technologies ought to be built. And we can't reduce that to the material properties of a same technologies, not just material and technologies are also not inevitable, right? That we can't separate technology from the context that it's being developed and being used.

"Pathological" Definition 7: Technology is a way of seeing the world in instrumental ends-means terms, that projects a bogus scientific objectivity, hides the power of technology, and mistakenly presents things as natural when they are not.

Ok, that was a lot…what to take away?

- The meaning of "technology" is not as old nor as constant as we tend to think it is.

- Technological knowledge depends on tacit knowledge.

- Technological designs and development depend on choices people make, and these choices are value-laden.

- There are multiple, valid ways of thinking about technology. Each of them may be appropriate in certain circumstances.

- Beware of oversimplified, falsely objective understandings of technology!

Shoelaces as a Technology

- What is "tacit" about shoelaces?

- What kind of choices go or went into the design and use of shoelaces? What values are embedded in them?

- How are shoelaces…
  - An entity that produces an artificial function?
  - The intended outcome of a problem-solving process?
  - A combination of artifacts, techniques, and regimes/structures?
  - The outcome of a co-evolutionary process?
  - Etc.

Mini-Assignments: General Policies

- One per class (exceptions: our first class, our last class, and the day of the quiz)

- Intended to take the place of in-class activities, discussions, games

- Will be different for each class: instructions will be provided during the lecture and on Moodle

- Must be completed within two days (I suggest doing them right after the corresponding lecture). Assignments from Monday classes will be due by 2:45pm on Wednesdays, and assignments from Wednesday classes will be due by the end of the day on Friday. **Half credit for late assignments.**

- All ten assignments will be graded for completion (= 10% of your final grade). Two random assignments will be graded for quality (= another 10% of your final grade).

Mini-Assignment #1: Defining a Specific Technology

- Pick a technology. (It could be something simple or complex; something physical or virtual; a category of technologies or one particular thing: it's up to you!)

- Explain how the technology that you have picked corresponds to **three** of Nightingale's six definitions of technology. (You pick which three definitions you want to use.)

- Post your justifications in the discussion forum on Moodle. Please post directly in the forum and do not upload a file.

- Due by the end of the day on Friday, May 8.

Reflection Essays

See handout posted on Moodle. Reflection essays are an opportunity for you to reflect on the readings and class discussions and communicate your own thoughts about technology and society. There is no "right answer" or specific point of view that I am looking for in your essays.

In general, your essays should have:

- A beginning, a middle, and an end.
- One central argument with 2-3 supporting reasons and evidence for each reason.
- Proper in-text citations AND a list of references at the end of the document.

Reflection Essays

Choosing a topic:

- Pick an aspect of the readings or class discussion that stood out to you in some way.

- Think about *why* it stood out: did you strongly agree or disagree? Was there a concept or term that was brand new for you? Could the author have added or changed something to strengthen their argument? Do you see a connection (that we haven't already discussed at length) between two or more texts/lectures/ideas? Or between an idea from class and something else that you know or have experienced?

- Develop your reaction into an *argument*. Outline your argument, reasoning, and evidence before beginning to write.

Reading Hints for Next Week

The Technology-Society Relationship
- During next Monday's class, we will return to the concepts of technological momentum and technological lock-in that Nightingale mentions, as part of a larger discussion about power, agency, and the technology-society relationship.
- *Langdon Winner, "Do Artifacts Have Politics?"*
  - Winner's article begins with a theoretical discussion, but quickly introduces multiple examples that illustrate his arguments.
  - Try to understand the **different ways** in which he says technologies can "have politics."
- *Lawrence Lessig, "Four Puzzles from Cyberspace"*
  - Are the cases that Lessig describes examples of any of Winner's types of political technologies? How do you think Lessig's stories or puzzles relate to Winner's arguments?