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Lesson 2 Glossary

Vocabulary

accrue (verb): to accumulate or add to periodically.

agile (adjective)*:* In engineering, “agile” has a special meaning. In the most simple terms, agile development processes mean that larger projects are broken down into smaller, complementary pieces. Work on the separate pieces can happen at the same time, and developments are reports to all affected teams for constant updating and adjustment. Agile practices can lead to quicker solutions.

analyze (verb): to examine methodically with the purpose of explaining or interpreting the data or information.

assembly/assemblies (noun/plural noun): As used in this excerpt, the word “assembly” or “assemblies” is a noun that means one component made of several or many smaller components. There is also a verb form of “assembly,” which means “to gather together; to put together,” and it can refer to things or groups of people.

downside (noun): disadvantage.

deploy (verb): to bring to action; to implement

deployment (noun): an action. Example: The deployment of ASCI for this project was a brilliant idea.

determine/determines (verb): to come to an answer after research, experimentation, thought, or other systematic observation. Example: The team determined that ionization would not be the right process.

mission (noun): Most companies have a “mission” or “mission statement” that guides their vision for the company’s goals and outcomes. These are often highlighted on the company website, or they might be found in yearly company reports.

potential (adjective): possible. As shown in the context within this Lesson, the word potential is used as an adjective. The same word can also be a noun.

pool (verb): to accumulate.

ROI: short for “Return on Investment,” a term in business practice that means is a measurement of evaluating if a project or process will bring in profit and how long it will take to see that profit.

stats (noun, plural, informal): statistics.

trade-offs (noun, plural): listing of advantages and disadvantages.

viability (noun): something has the potential for success; it has the potential to be an effective, efficient, or elegant solution .

Idioms and Sayings

here’s the thing (idiom): means “here’s my main point”

ready for prime time: (idiom, taken from television): means “completely ready”

I tell you what (idiom): means “let me tell you something”

on board (idiom): means “in favor of”

for one (idiom): means “as an example of one”

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Lesson 2
Modal Verbs: Quick Review

Modal verbs are auxiliary verbs which, when used together with a simple verb, help define the nature of the action by describing special properties: necessity, possibility, and obligation, for example. This chart expands upon the most common uses of the modal verbs described in the course modules; it is, by no means, an exhaustive review of modal verbs, which are quite complex.

Modal verb	*Meaning* Uses	Example Sentences/Questions
can	*ability* (present or future tense). Functions as a direct request. Combine with *not* for a negative.	Peter can finalize those calculations. Can you redesign that component? I can't do that work because I don't have clearance.
could	*ability (present or past tense).* Functions as an indirect request; considered very polite. Describes a hypothetical cause and effect construction about something not true in the present. Can also report speech of others (past form of can) Combine with *not* for a negative.	Last week, I could provide the most recent data points, but not this week. Could you purchase a new set of calipers with the next supply order? If our project was funded, we could buy the borescope. Amy said she could do it. He could not make the prototype in the 3D printer.
may	*possibility* (present or future tense). Functions also as a polite request. Combine with *not* for a negative.	Check the newest data; we may have a problem with the calibration. May I help you? They may not be able to deliver the parts on time.

might	*lesser possibility* (present or future tense). Presents a hypothetical cause and effect Provides a recommended alternative. Can report the speech of others (past form of may). Combine with *not* for a negative.	It seems they might be wrong. If the tachometer breaks down, we might have to call Dave to fix it. We are out of licenses for that cloud software. You might call to arrange for more licenses. Alex told us that he might move to another research group in the company. He might not sign the new contract.
Modal verb	**Meaning** and **Use**	**Sample Sentences/Questions**
must	Strong obligation or requirement (future tense). Used to convince or persuade. Used for strong supposition. Combine with *not* for a negative.	You must finish the work by next week. You must listen to this podcast; it talks all about the new research coming out of MIT. They offered an excellent price for the sensors; they must want our business very badly. They must not alter the software code after Monday.
shall	Declares a requirement (formal usage, present or future) Declares a future event (formal). Denotes formal invitation. Declares a prohibition (formal).	He shall do the work or be fired. The team shall have this to the CTO by Friday at 3pm. Shall we begin the meeting? That team shall not do any more work on this project.
should	Obligation in present or future. Denotes advice or recommendation. Combine with *not* for a negative; that is, a prohibition.	He should confirm the dimensions with the client before doing any more work. We should attend the on-boarding session. I hear that it's very useful. Company guests should not pay for their own dinners.
will	*prediction* (future tense). Denotes willingness. Indicates the result in a cause/effect construction in the present. Combine with *not* for a negative.	The new program will do the calculations for us in half the time. Our contractors will happily provide a new estimate. If the shipment does not arrive, they will not be able to move forward on the prototype. They will not arrive on time.

would	Polite request (present, past, future tenses) Can report the speech of others (past form of will). Functions to set out a hypothesis that is contrary to current state/fact. Denotes habitual action in the past. Combine with *not* for a negative.	Would you please stay longer to help me with this project? Robert said they would re-run the code to double check it. If he took the CAD training, he would be able to get a raise. Before last year, he would never volunteer to take on new tasks. Janet would not allow us to use cloud servers for this project in order to protect proprietary information.

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Lesson 2 Listening Transcript #1

For an explanation of terms in boldface, see the Glossary.

Myra: Hello, Ben? It's Myra. Listen, I'm here at the Midwest Electronics Conference and I've just finished attending two great sessions on carbon nanotubes, especially one by Allen White. **Do you have a minute?**

Ben: Oh, that's right. You're at the Chicago electronics fair. I'm glad you're finding it productive. What made the session so impressive?

Myra: Well, the session was really informative, because it focused a lot on wafer size. It reminded me of last year, when we were complaining about the wafer size -- and looking for some practical way to get it below 22 nanometers for that client from New York.

Ben: Of course. And if I'm remembering right, we weren't sure we could still get the same amount of power if we were to switch to nanotubes, if they became viable, just for the sake of a smaller wafer. So that's why we stayed with the old system.

Myra: Right. And **here's the thing**. White says there have been huge improvements in the technology just in the past five years. He had a lot of

stats on both power and reliability that give me a lot of confidence, and I think it will make clients like Mohdhem confident, too.

Ben: Hmm. Interesting. Did you get details on his sources and some of the newer research? Just three years ago, a lot of researchers were certain that carbon nanotubes weren't yet **ready for prime time**, so we have to keep those reservations in mind. And while we're starting to get interested, absolutely, we certainly can't recommend **sub- optimal** materials to our clients, right?

continued

Myra: Of course. He did give details on his sources in his slides. And I tried to **touch base** with him after the presentation to find out more, but he had to leave immediately. I do have his contact information, though.

Ben: **I tell you what**. **Can I ask you to** do more research, and then set up a meeting with the rest of our staff? It will be great for them to hear about your findings, and we need to keep working together as a team over a good period of time to really understand the **tradeoffs of nanotechnology.**

Myra: Well, I'm **on board** already. White mentioned that carbon nanotubes have proved to be 100 times stronger than steel--and that they conduct well

and are lightweight. The research is conclusive, I'm telling you So what could be the **downside** to using them?

Ben: That's what we need to find out. Cost, **for one**: maybe endurance over the long term in terms of our needs, which you have to admit and pretty specialized. Come and see me when you get back. Then we'll discuss all the information.

Myra: Got it. **I'm on it.**

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Lesson 2 Listening Transcript #2

Ben: So, carbon nanotubes aren't completely risk-free, right?

Myra: What do you mean ?

Ben: I've just read in *Toxicology Today* that the tubes can cause harm in mice, just like asbestos fibers can.

Myra: Are you saying that safety is your main concern?

Ben: Actually, I'm worried about both the health and the environmental risks.

Myra: Which use of nanotubes is actually harmful to humans? Do you know?

Ben: Well, for one, there are new studies about Vantablack - you know, the carbon nanotube-based spray paint. It has extremely low density and can cover a significant surface area, so it could affect breathing. We were considering using it.

Myra: So, we need to know how Vantablack can be ingested or inhaled, don't we?

Ben: Exactly. Before even considering Vantablack, we need thorough research on how easily the particles can get distributed, and their effects. Right?

Myra: I agree. I'll make that my first priority this month. Does that help?

Ben: Sounds like a plan.

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Lesson 2 Reading Excerpt

This is an excerpt from the document about a project that has already begun, called the LogCatran Research Project. The engineering team will assess the viability of carbon nanotube transistors as replacements for traditional silicon transistors. A current client, Mohdhem Industries, has expressed great interest in using carbon nanotube transistors in the assemblies that they purchase from Logrify. Logrify's engineering team has been working on the LogCatran project for two months, and you need to familiarize yourself quickly with the product concept and the progress of the project. Here is an excerpt of the Project Goals document that launched the project internally at Logrify.

If you are unfamiliar with the words in bold, they can be found in the Lesson 2 Resources in the Vocabulary section.

Mohdhem Project Goals

Within the next 12 months, the Engineering Research and Development (R&D) team at Logrify will research **viability** for using carbon nanotube transistors for the Mohdhem Industries application. This is a multi-phase, **agile** process. The Engineering R&D team has been asked to assess several issues, shown here in order of importance:

1. Are carbon nanotube transistors viable for Mohdhem's needs in the immediate future (one year)?
2. What other carbon nanotube applications might fit within Logrify's **mission** as a company?
3. If Logrify invests in carbon nanotube applications beyond this client's need, will it be a profitable endeavor?

Project Teams

Logrify's engineering team will be divided into working groups. Initially, these two groups will be formed:

- Power Team: Assess and **analyze** the **potential** power savings by using carbon nanotube resistors on the client's wafer bank; provide a report to Logrify's technical management team as to the impacts of any power savings for applicable transistor assemblies.

- Viability Team: Assess the viability, stability, and reliability of the current published research about carbon nanotube transistors; provide a report to Logrify's technical management team that summarizes the state of the technology, the state of the industry, and if the technology could be **deployed** for this project.

If the Power Team and Viability Team determine the project worthwhile, a third team will be formed:

- Financials Team: Assess the financial costs or savings by moving all of Logrify's technology base to carbon nanotube transistors; develop an **ROI (Return on Investment)** for **deployment** if the economic assessment is positive.

Background of the Project

Because carbon nanotube research and development has grown quickly in the last decade, Logrify is interested in using that technology for its resistors, which could increase speed and lower size of transistors. Right now, Logrify's silicon-based transistors measure around 22 nm. If carbon nanotube transistors become viable, they will measure around 9 nm, which is a significant size savings on each silicon wafer. As well, carbon nanotubes are better at conducting electricity. It is easy to understand why our clients would be excited about this technology.

Representatives from Mohdhem Industries heard about the potential for carbon nanotube transistors at a recent conference. They did not gather specifics from the conference presenter, and so they have turned to us to explore the potential for their wafers that they currently buy from Logrify.

As of 2017, researchers at IBM have been able to grow straight carbon nanotubes on a quartz array, which can then be transferred to a CMOS (complementary metal-oxide semiconductor) wafer. Logrify's teams need to determine if the research on carbon nanotubes and their use on transistors is advanced enough to use for manufacturing.

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