Unit -3

CAD - EVOLUTION & HISTORY

Computer Aided Design, commonly referred to as CAD, is used in a wide variety of fields to accurately design and edit structures, components, and countless other applications.

- What had previously been done using a pencil and paper was replaced over time with the development and adoption of computers.

- In fact, the history of CAD closely parallels the history of the computer, allowing for more advanced programs and techniques as the processing power of the computer grew over the years.

- The idea of computer aided design grew from simple 2D designs into complex, multi-layered 3D structures with detailed meta-data and kinematic movement.

- The precision, versatility, and editing offered by CAD software revolutionized the architecture, engineering, and manufacturing industries.

- Computer-aided design (CAD) is the use of computers (or workstations) to aid in the creation, modification, analysis, or optimization of a design. CAD software is used to increase the productivity of the designer, improve the quality of design, improve communications through documentation, and to create a database for manufacturing.

- CAD output is often in the form of electronic files for print, machining, or other manufacturing operations. The term CADD (for Computer Aided Design and Drafting) is also used.

- Its use in designing electronic systems is known as electronic design automation (EDA).

- In mechanical design it is known as mechanical design automation (MDA) or computer-aided drafting (CAD), which includes the process of creating a technical drawing with the use of computer software.

- CAD may be used to design curves and figures in two-dimensional (2D) space; or curves, surfaces, and solids in three-dimensional (3D) space.

CAD is an important industrial art extensively used in many applications, including automotive, shipbuilding, and aerospace industries, industrial and architectural design, prosthetics, and many more.

Benefits of Digital Prototyping Design

Prototyping is an experimental process where design teams implement ideas into tangible forms from paper to digital. Teams build prototypes of varying degrees of fidelity to capture design concepts and test on users.

With prototypes, you can refine and validate your designs so your brand can release the right products.

- Money
- Time
- Compatibility
- Efficiency
- Accuracy
- Collabration
- Testing
- Attainable or acessable

- Money. First and foremost in the mind of many manufacturers will be the cost associated with prototyping a product.

- Digital prototyping helps to minimize the actual building of things – which in turn reduces both the labour required during the process, and the materials
- Reduced time and costs.
- Improved and increased user involvement.

- Prototyping most importantly helps eliminate misunderstandings and miscommunications during the development process.

- Reduced time and costs: Nothing makes customers happier than projects that come in under budget. Prototyping improves the quality of requirements and specifications provided to customers.

3D modeling

- In 3D computer graphics, **3D modeling** is the process of developing a mathematical representation of any *surface* of an object (either inanimate or living) in three dimensions via specialized software.(catia, solid works, pro-e, unigraphics etc..,)

- The product is called a **3D model**. Someone who works with 3D models may be referred to as a **3D artist**.

  It can be displayed as a two-dimensional image through a process called *3D rendering* or used in a computer simulation of physical phenomena. The model can also be physically created using 3D printing devices.

Reasons to Use 3D Modeling in Product Design

- 3D model can be a great multifunctional tool helping manufacturers and designers first design, then create and finally market and sell their products.
- Showcasing a product in 3D is the best alternative for spectacular presentation of a new product design or idea to other company members or potential customers. It allows quick changes in case when new ideas cross the mind and require minor or even major alterations.

- In addition, 3D modeling expands opportunities for the product’s marketing campaign, because 3D models can be animated to show all abilities and features of a product, or even can be used in interactive applications allowing potential customers to interact with product model, rotate it, or even disassemble and reassemble.

- Moreover, information stored in a 3D model can be used to automate almost any manufacturing process.

1. Prototyping
2. Precise Measurements
3. All-round View
4. Promotion and Marketing
5. Eye-catching Animation
6. Production

1. Prototyping

- Often 3D models are used to create a product prototype to evaluate its design concept, details, manufacturing costs, etc.
- Approach for creating a product prototype is truly flexible: 3D model can be created either from a hand drawing, from a 2D sketch or even from an idea allowing 3D designer to easily work on a product design and refine the model without creating any additional sketches demonstrating product from different views.

2. Precise Measurements

Modern 3D modeling software allows demonstrating the size of a product relative to other known objects. This real scale of products allows potential customers imagine how large or small the product will be when it is finished.

3. All-round View

- A 360-degree view of the product model allows viewing the product from all angles, seeing the smallest details of it, and better preparing for production and packaging. Three dimensional view of a product is essential for almost all production stages and is absolutely required for presentation of the product.
- Interactive 3D presentations allow the users zooming the product in and out, rotate it and view from different angles for better visual expression.

4. Promotion and Marketing

Photo-realistic production-ready 3D models can be easily inserted in any commercial, presentation or advertising real for effective promotion of the product.

A growing number of companies has already benefited from three-dimensional content in their marketing campaigns and sales promotions.

5. Eye-catching Animation

Quality animation of a product can come as a bombshell ensuring success to the marketing campaign. It can showcase exactly what the product can do and what the customers will get once the product is ready for use.

6. Production

3D modeling is the best alternative for automating the manufacturing processes. The data stored in 3D model can be transmitted directly to machinery allowing to automatically start production with pinpoint accuracy.

Design for manufacturability (also sometimes known as design for manufacturing or DFM) is the general engineering practice of designing products in such a way that they are easy to manufacture.

These DFM guidelines help to precisely define various tolerances, rules and common manufacturing checks related to DFM.

- Design for Manufacturing (DFM) is the process of designing parts, components or products for ease of manufacturing with an end goal of making a better product at a lower cost.
- This is done by simplifying, optimizing and refining the product design. The acronym DFMA (Design for Manufacturing and Assembly) is sometimes used interchangeably with DFM.

Principles examined during a DFM are:

- Process
- Design
- Material
- Environment
- Compliance/Testing

DESIGN STYLED COMPONENTS

Styled Components allow you to style any custom component that you've created. First, the custom component must receive the proper class Name and pass it to the underlying DOM element.

Once that is done, pass the custom component to the styled function and invoke it as a Tagged Template to receive a new Styled Component.

Features of styled-components

1. Style inheritance

2.Passing props

3. Theming

4. Global styling

5. Switching component types
6. Styling regular components
7. Specifying attributes etc..

Top-Down and Bottom-Up Design Approach

Introduction to Top-down and bottom-Up Design

- There are two design approach which are used for algorithm designs namely Top-down design approach and Bottom-Up design approach.

- Top-Down design approach divides the complex module into smaller sub-module whereas Bottom-up design approach combines the smaller sub-module into the larger complex module.

- In this post, We are going to explore more about these two design approaches.

Top-Down Approach

- As mentioned, the Top-Down design follows **splitting** design approach which breaks a complex algorithm or a problem into smaller segments called modules, this process is also called as modularization.

- A top-down approach (also known as stepwise design) is essentially the breaking down of a system to gain insight into the sub-systems that make it up. In a top-down approach an **overview** of the system is formulated, specifying but not detailing any first-level subsystems.

In Top-Down design approach following steps are followed:

- Take the complex whole problem and split it into two or more parts.
  - Find the solution to these parts.

- If split parts turn out to be too big to be solved, split them further.
  - Find solutions to those sub parts.
- Merge solutions according to the sub-problem hierarchy.
- If all parts have been successfully solved, the whole problem is solved.

Eg…,

C Programming follows Top-down design approach.

Bottom-Up Approach

- As mentioned, the Bottom-Up approach follows the merging design approach which combines the smaller sub-module into the larger complex module. Models are built from simple components connected.

In Bottom-Up design approach following steps:

- Take the smallest sub-part of the complex module.

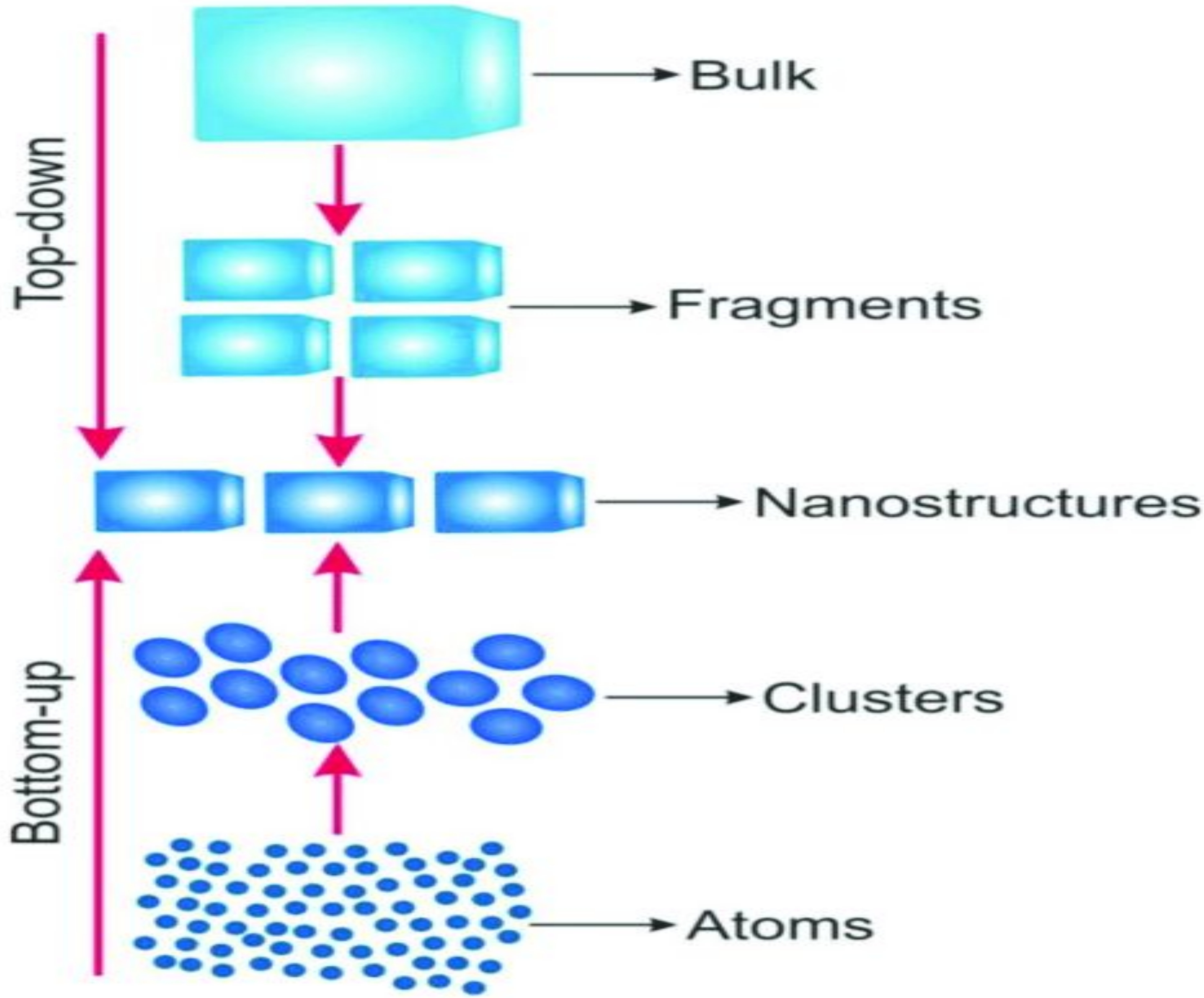
- Solve that sub part.
  - Take other smallest part ,solve that sub part and so on…
- Merge all the smallest sub-part iteratively to get the final solution.

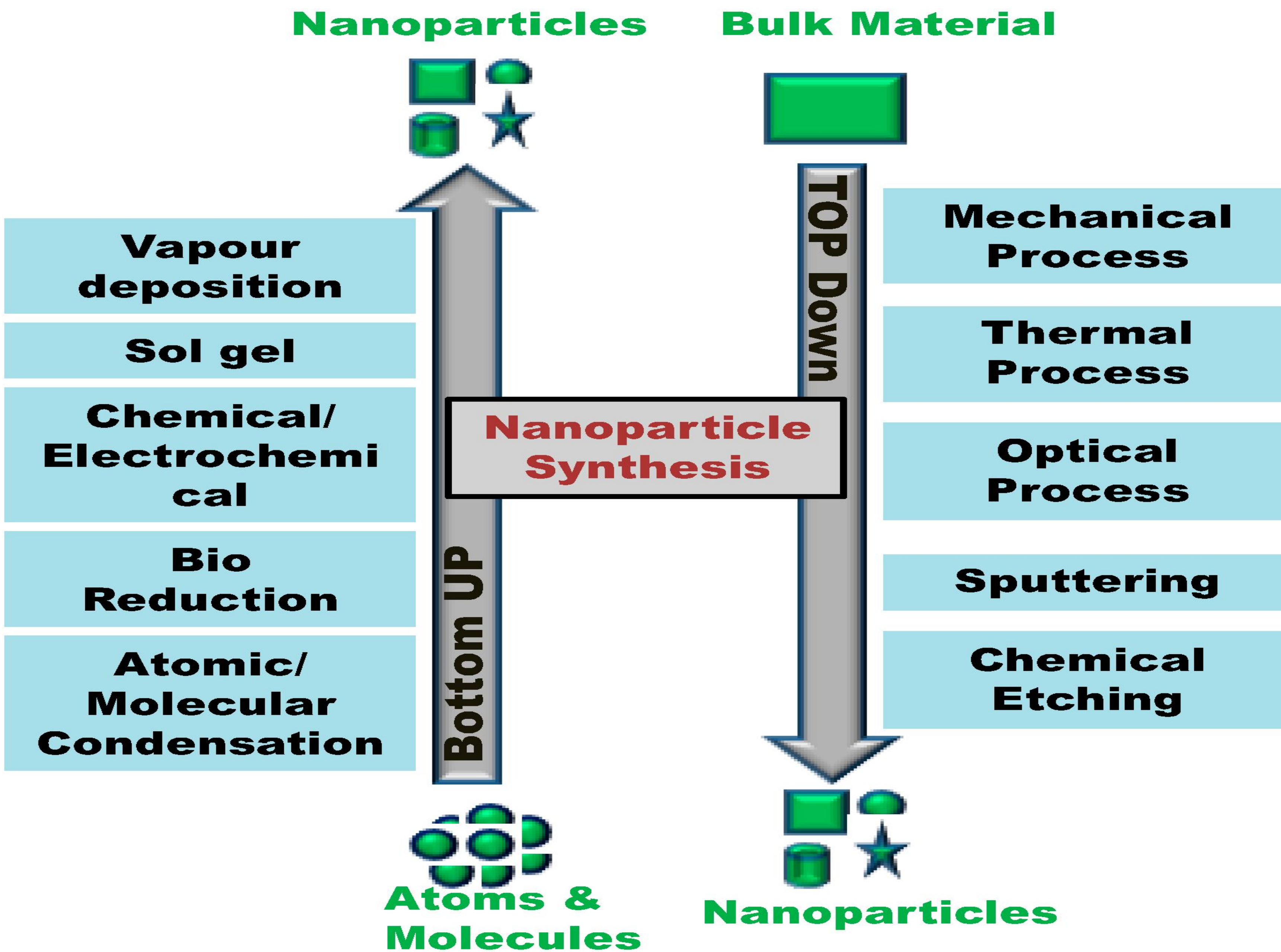
Difference between Top-Down and Bottom-Up design approach

Top-Down Design Approach	Bottom-Up Design Approach
Top-Down design approach divides the complex module into smaller sub-module.	Bottom-up design approach combines the smaller sub-module into the larger complex module.
Follows splitting technique.	Follows merging technique.
This approach contains redundant information.	This approach easily eliminates redundant information.
Communication among steps is not mandatory.	Communication among steps is mandatory.
The individual modules are thoroughly analyzed.	Works on the concept of encapsulation and data-hiding.
A programming language like C follows the top-down design approach.	A programming language like C++, Java follows the bottom-up design approach.

top down	bottom up
— start with the large, complex problem, and build a solution for it by understanding how to build it/break it down into smaller sub-problems, smaller solutions	— start with the smallest solutions, the smallest subproblems, and then build up each solution until we arrive at the solution to the larger subproblem.
— memoization as we break down the problem into parts: solve F_{n-1}, then F_{n-2}, then F_{n-3} ...	— solve the Fibonacci sequence starting with 0 and 1 first, memoizing as we build our way up to whichever Fibonacci number we're trying to find.

* A benefit to the bottom up dynamic programming approach (DP) is that we can save space since we're working our way up. We only need to really memoize the last 2 values, which means we can achieve constant space O(1).


Bulk
Fragments
Nanostructures
Clusters
Atoms
Top-down
Bottom-up


Nanoparticles
Bulk Material
Vapour deposition
Sol gel
Chemical/ Electrochemical
Bio Reduction
Atomic/ Molecular Condensation
Bottom UP
TOP Down
Nanoparticle Synthesis
Mechanical Process
Thermal Process
Optical Process
Sputtering
Chemical Etching
Atoms & Molecules
Nanoparticles

There are two approaches toward the programming

1. Top-Down Approach 2. Bottom-up Approach.

These are known as information processing strategies.

Top-Down Approach	Bottom up Approach
• Emphasis is on doing things (algorithms)	• Emph[illegible]is is on data rather than procedu[illegible]
• Large programs are divided into smaller programs known as functions.	• Program[illegible] divided into what are known [illegible]ects.
• Most of the functions share global data.	• Data structures [illegible]esigned such that they cha[illegible]tics the objects.
• Data move openly around the system from function to function.	• Functions that operate [illegible] data are tied together in [illegible] structure.
	• Data is hidden and cannot accessed by external functions.

- What Is a **Bill of Materials** (BOM)? A **bill of materials** (BOM) is an extensive list of raw **materials**, components, and instructions required to construct, **manufacture**, or repair a product or service.

- A bill of materials (BOM) is an extensive list of raw materials, components, and instructions required to construct, manufacture, or repair a product or service.

- A bill of materials usually appears in a hierarchical format, with the highest level displaying the finished product and the bottom level showing individual components and materials.

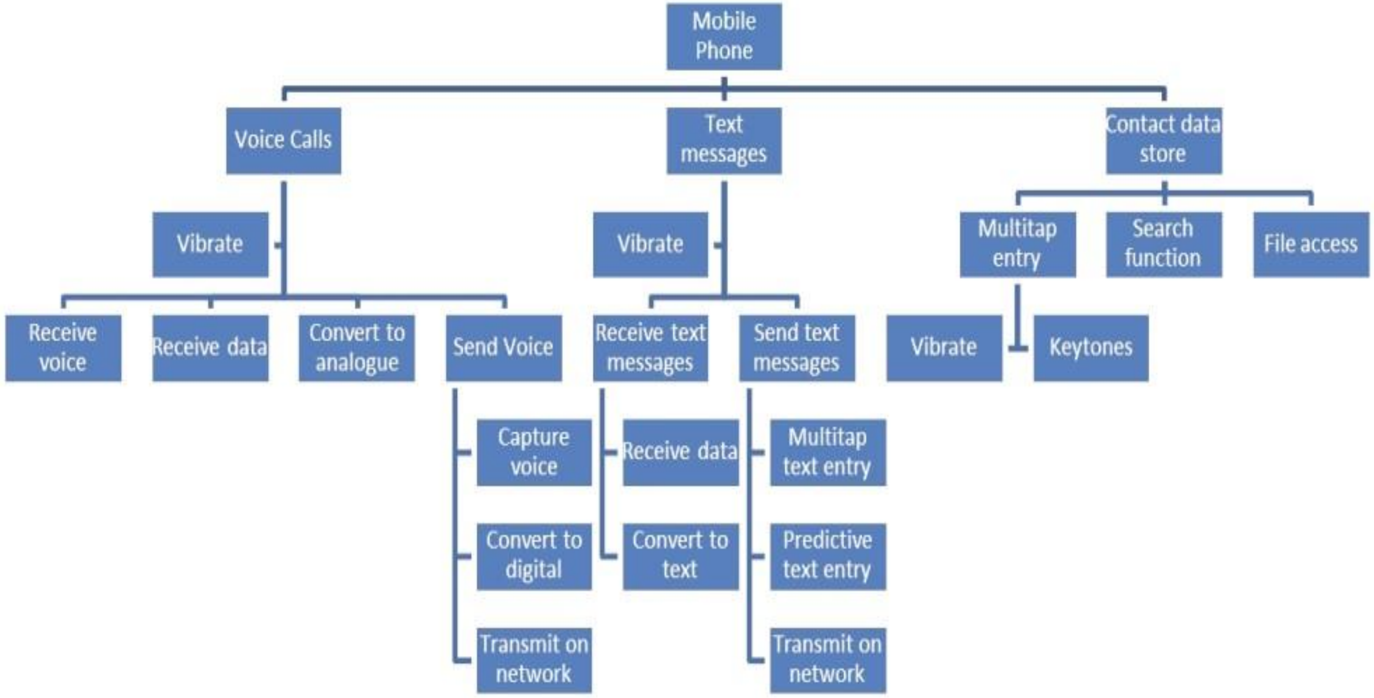
- There are different types of bills of materials specific to engineering used in the design process; they're also specific to the manufacturing used in the assembly process.

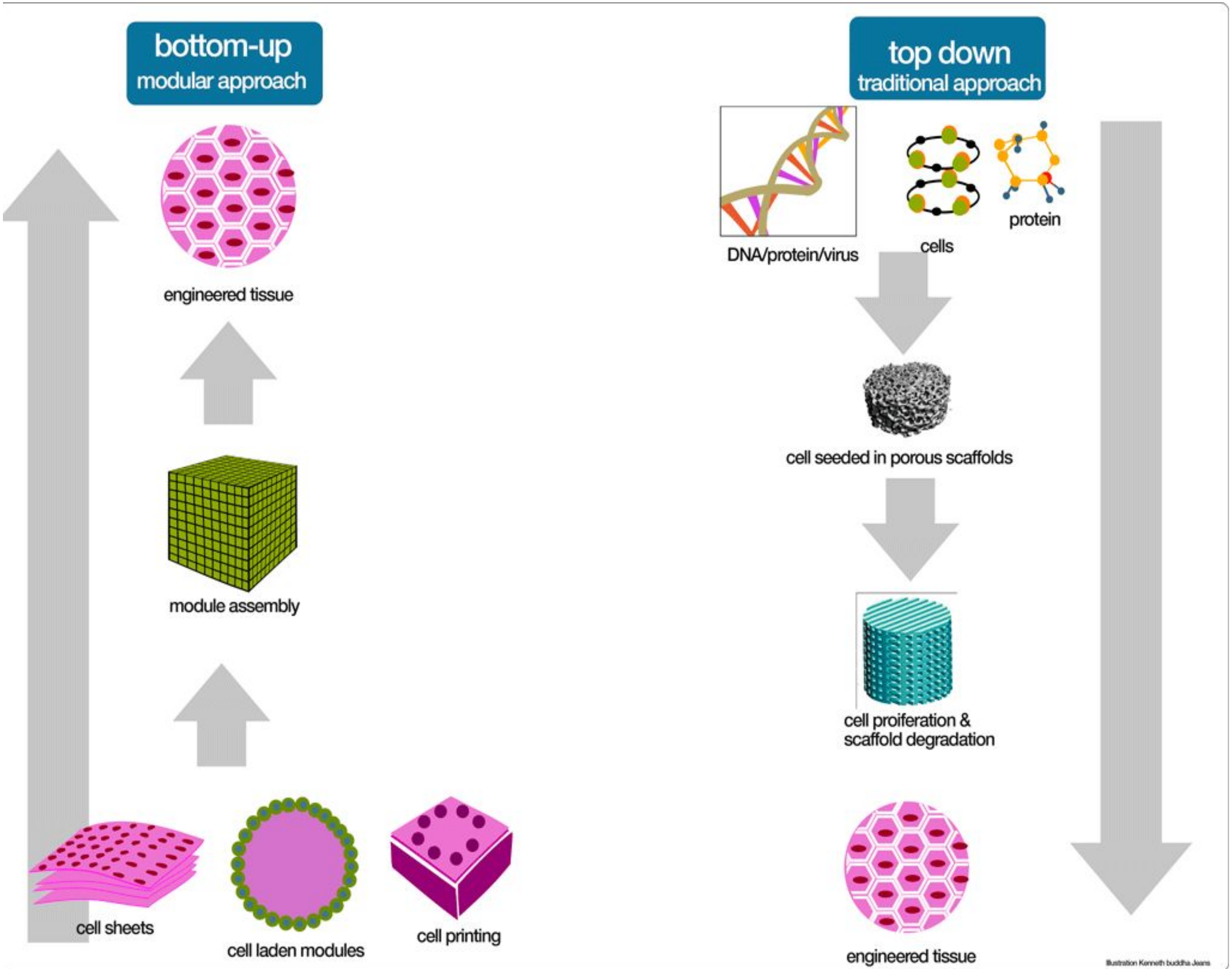
- The engineering BOM is often organized by engineers based on a computer-aided design (CAD) drawing. For a finished product, there may be more than one engineering BOM created. This is a part of product lifecycle management.

- **Top-Down Design**, is characterized by an extensive planning and research phase that leads into the development of a product.

- **Bottom-Up Design**, takes the opposite approach. While goals for a product are still outlined, the assembly of a product is done on a system by system basis.

A Mobile phone system



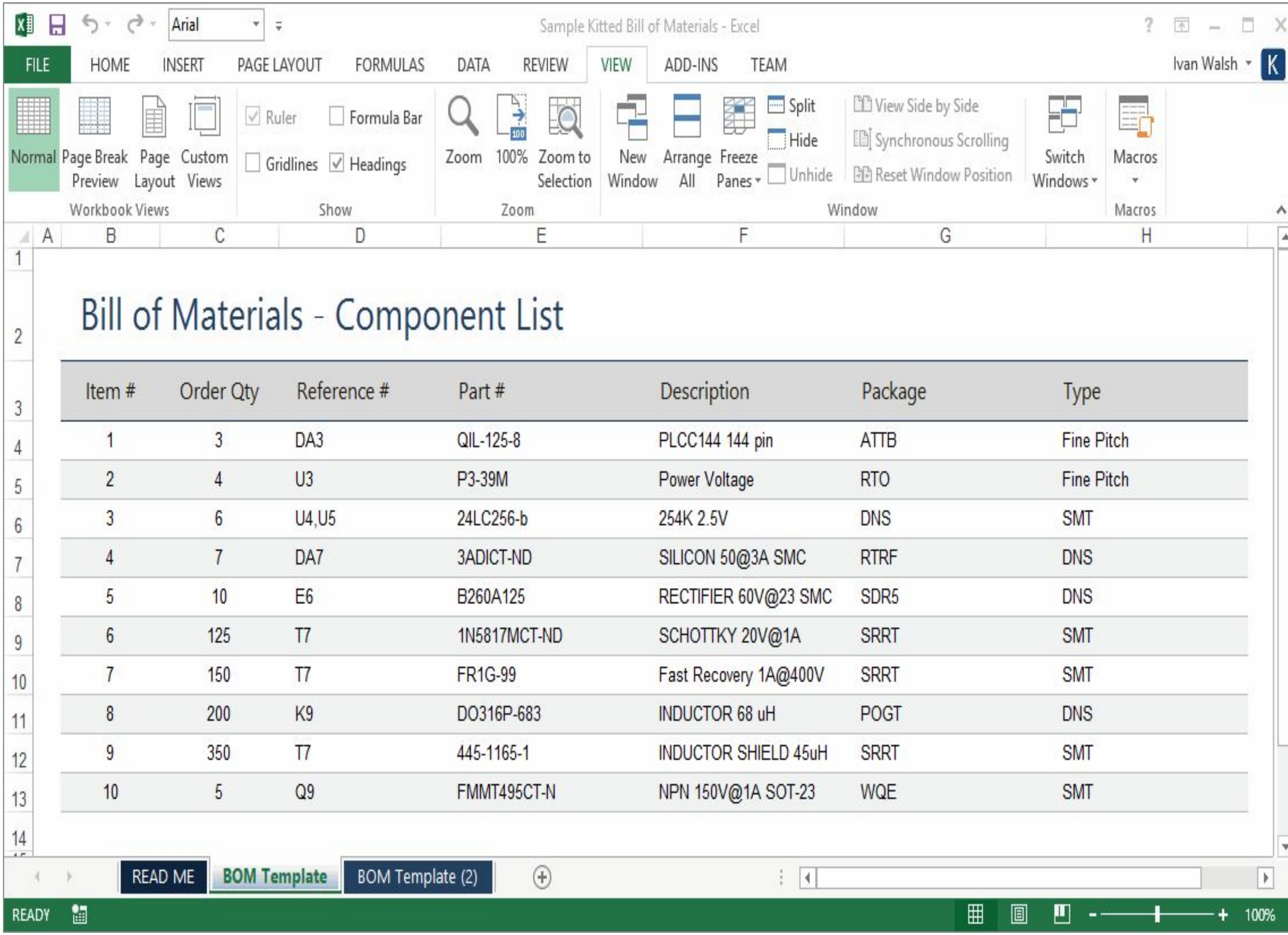


bottom-up
modular approach
engineered tissue
module assembly
cell sheets
cell laden modules
cell printing
top down
traditional approach
DNA/protein/virus
cells
protein
cell seeded in porous scaffolds
cell proiferation &
scaffold degradation
engineered tissue
Illustration Kenneth buddha Jeans

Bill of materials (BOM) is a comprehensive inventory of the raw materials, assemblies, subassemblies, parts and components, as well as the quantities of each, needed to manufacture a product.

A BOM is a centralized source of information used to manufacture a product.

A bill of materials is often shown in a hierarchical way, from the finished product all the way down to individual components and materials.



Bill of Materials - Component List

Item #	Order Qty	Reference #	Part #	Description	Package	Type
1	3	DA3	QIL-125-8	PLCC144 144 pin	ATTB	Fine Pitch
2	4	U3	P3-39M	Power Voltage	RTO	Fine Pitch
3	6	U4,U5	24LC256-b	254K 2.5V	DNS	SMT
4	7	DA7	3ADICT-ND	SILICON 50@3A SMC	RTRF	DNS
5	10	E6	B260A125	RECTIFIER 60V@23 SMC	SDR5	DNS
6	125	T7	1N5817MCT-ND	SCHOTTKY 20V@1A	SRRT	SMT
7	150	T7	FR1G-99	Fast Recovery 1A@400V	SRRT	SMT
8	200	K9	DO316P-683	INDUCTOR 68 uH	POGT	DNS
9	350	T7	445-1165-1	INDUCTOR SHIELD 45uH	SRRT	SMT
10	5	Q9	FMMT495CT-N	NPN 150V@1A SOT-23	WQE	SMT

Collaborative design is the new norm for companies and learning the ins and outs of this phase are vital to the UX (user experience) process.

- Collaborative design is a process that brings together different ideas, roles and teammembers.

- Collaborative design is a multi-staged UX (user experience) process that involves planning and strategy developed by user feedback. The design phase of the UX process is iterative.

- Collaborative design is related to collaborative marketing and is part of a UX process that achieves different stages, along with design, to reach a final goal of a product or campaign. Imagine each UX process has a beginning, middle and end. (research phase, design phase, launch phase)
- The design phase is the middle, the research phase is the beginning and the launch phase is the end. Though this is a very simplied view of most UX processes, it helps you understand the grand scheme of where collaborative design falls into place.

When Should Teams Use Collaborative Design?

- ❖ As we've already talked about, the collaborative design process is a three-pronged approach that takes in the start, middle and end of a project.

- ❖ Yet there are some parts of a project where collaborative design is especially helpful, like:

- ✔ Deciding on the vision and scope of a project.
- ✔ Gathering feedback and context throughout the design process.
- ✔ Promoting discussion and brainstorming to boost creativity.
- ✔ Solving specific design problems for clients.
- ✔ The design review and approval process.

- IBM's Global VP Design, Arin Bhowmick, says while finding ways to communicate effectively, move projects forward, and keep design creativity fresh and interactive can be challenging, it's possible with collaboration.

- "Though collaborating remotely takes work, patience, and perseverance, it doesn’t mean that achievements of co-located teams are out of reach,"