

Systems Thinking for Design

Session 1



INDIAN INSTITUTE OF INFORMATION TECHNOLOGY,
DESIGN AND MANUFACTURING,
KANCHEEPURAM

Dr. Karthik Chandrasekaran

School of Interdisciplinary Design and Innovation
(SIDI)

Recap

1. What courses did you learn last semester?
2. What were the relevant courses to this course?
3. What were the key learning from those courses?

Let us start – Exercise 1.1

Take the test at this website - <https://upgrader.gapminder.org/>



Introductory Session

Understanding IIITDM

DS2000: Learning Objectives & Course Structure

Exercise 1.2: What do these terms mean to you?

(10 min)

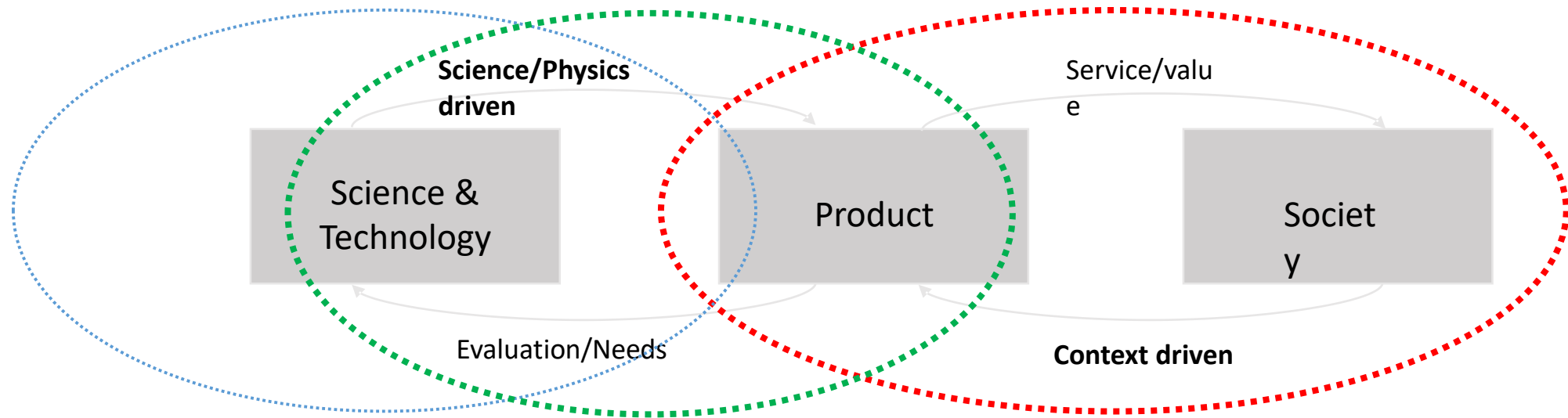
- | | | |
|--------------------------------|----------------------|------------------------|
| 1. Science (Natural / Social) | <i>Make-in-India</i> | 9. Product |
| 2. Engineering | | 10. Industrial Design |
| 3. Technology | <i>Startup India</i> | 11. Engineering Design |
| 4. Innovation | <i>Skill India</i> | 12. Prototype |
| 5. Entrepreneurship | IIITDM | 13. Manufacturing |
| 6. Management | | 14. User |
| 7. Enterprise/Business/Company | | 15. Customer |
| 8. Industry | | 16. Market |

Constraint: Should not exceed a page & should include all terms

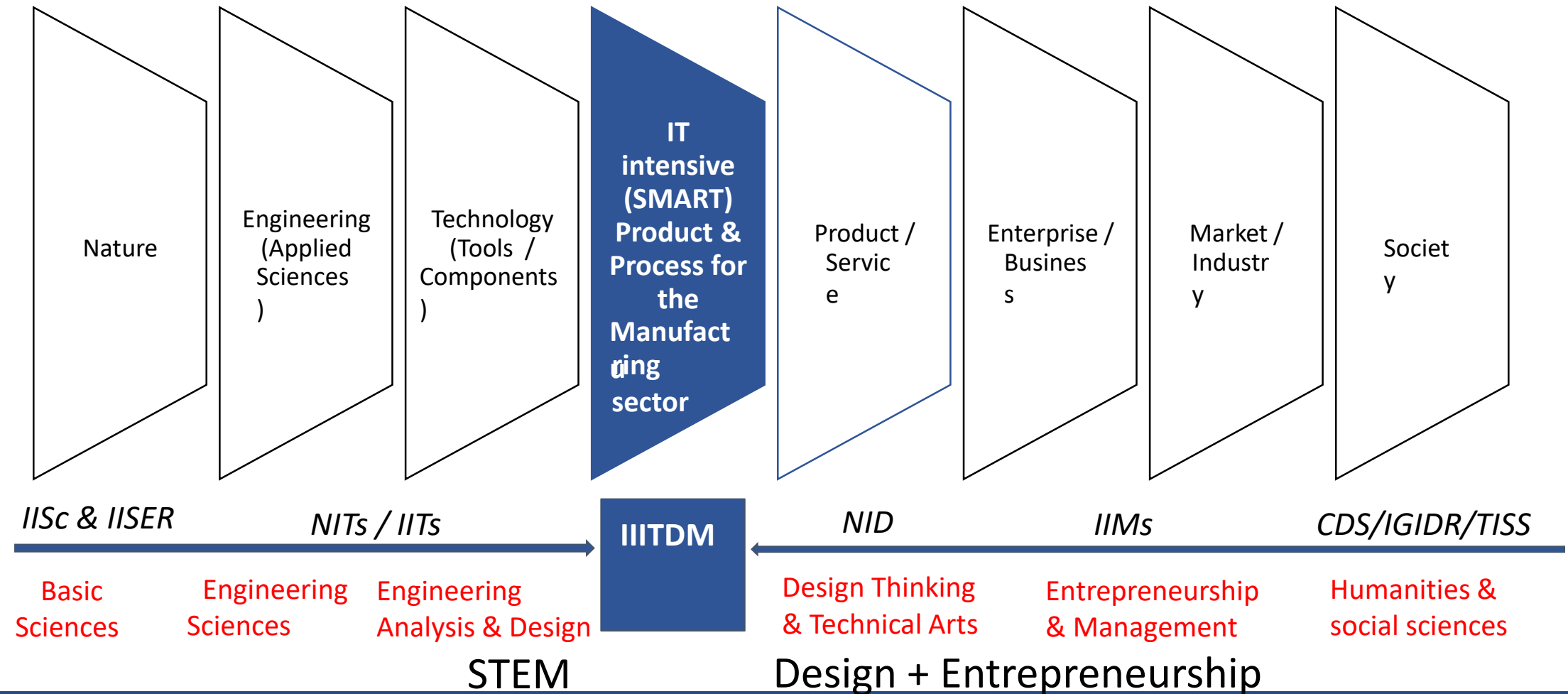
1. Scientist-engineer

2. Design-centric Engineer

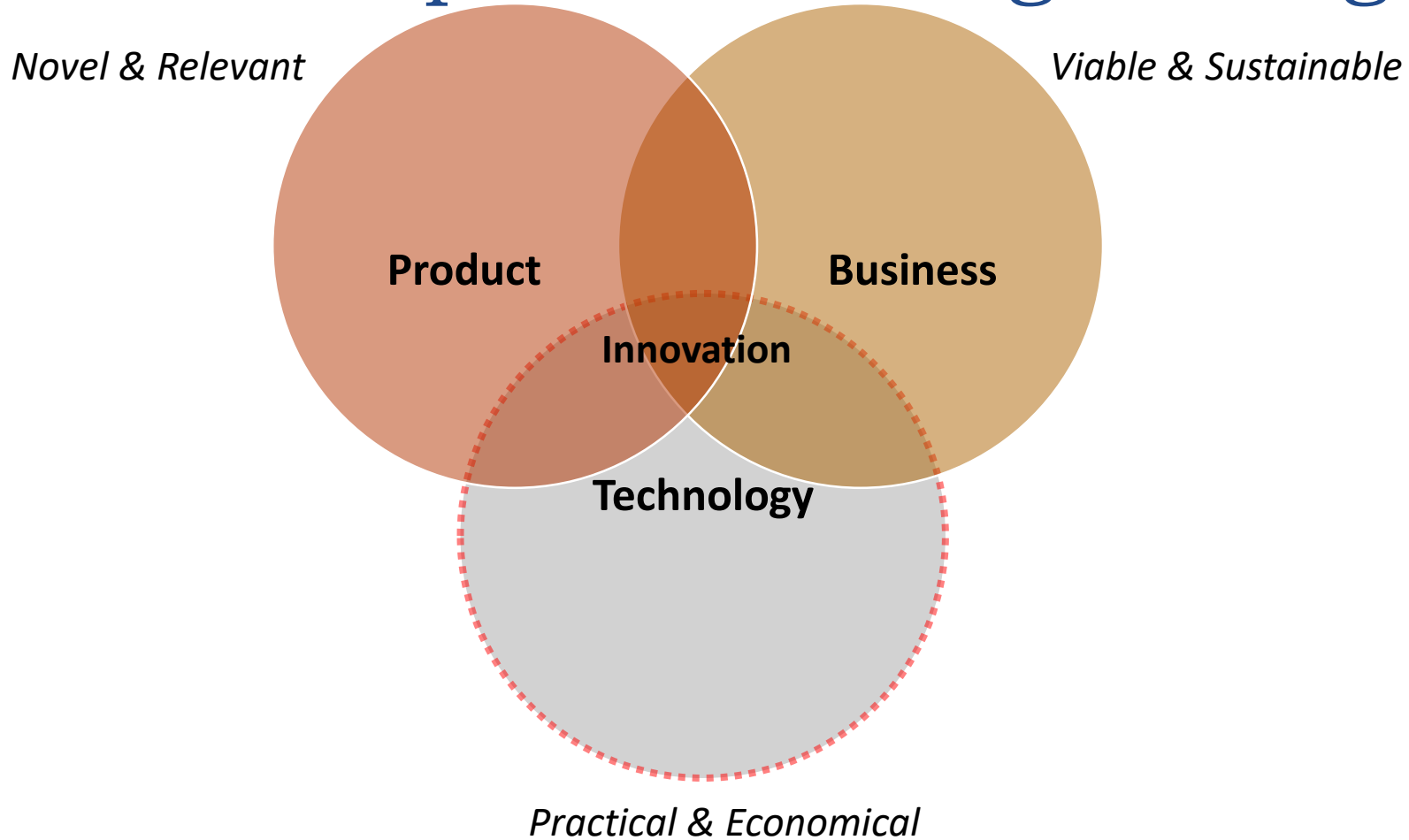
3. Product/Industrial designer



IIITDM: Conceptualized in 2003 and setup in 2007 to develop a new engineer for the manufacturing sector

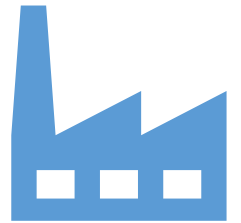


Intent of the Inter-disciplinary Design and Entrepreneurship Oriented Engineering

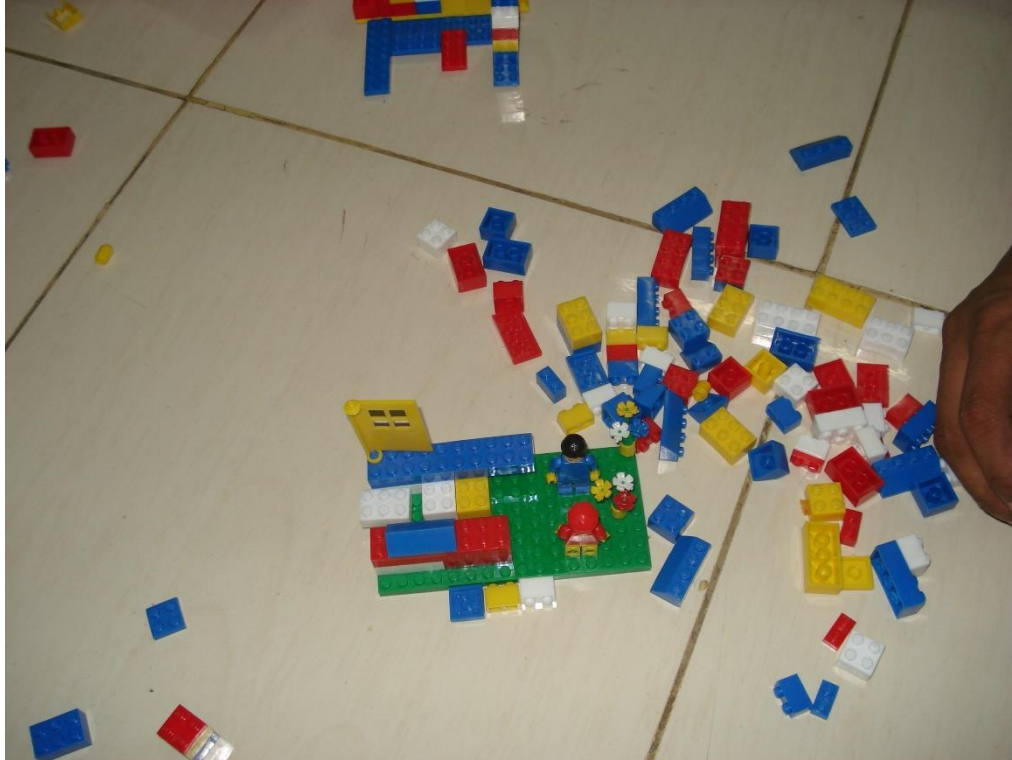


National Priority: Make-in-India & Manufacturing

- Phase-1 of Make-in-India happened with the Indian IT industry, 1995-2005 and laid the foundation for a digital ecosystem
- Phase-2 is the focus on increasing the **manufacturing sector** contribution to 25% of the GDP leveraging the digital ecosystem
 - **Leveraging Industry 4.0 (Smart and Advanced Manufacturing)**
 - CII-SR Initiative: Manufacturing and Digital Excellence (MADE)
 - Digital disruption at the shop floor & in capital goods
 - Importance of Design
 - IIOT and integration
 - **Startup India (Entrepreneurship & Job creation in the SME sector)**
 - **Skill India**



Exercise 1.3 (10 min): What competencies did you develop in Year-1 & how?



Relook at your first year courses and depict using the skills you have acquired in the first year
My assumption: all of you remember the courses

Category	Course Name
BSC	Calculus
BSC	Engineering Electromagnetics
BEC	Electrical Circuits for Engineers
BEC	Problem Solving and Programming
BEC	Materials for Engineers
DSC	Foundation for Engineering and Product Design
BSC	Engineering Electromagnetics Practice
BEC	Problem Solving and Programming Practice
HSC	Effective Language and Communication Skills

Category	Course Name
BSC	Differential Equations
SEC	Science Elective 1
BEC	Engineering Graphics
ITC	Data Structures and Algorithms
DSC	Sociology of Design
ITC	Design and Manufacturing Lab
PCC	Discrete Structures for Computer Science
ITC	Data Structures and Algorithms Practice
HSC	NSO/NCC/SSG/NSS
HSC	Earth, Environment and Design

The answer that is most common will receive lowest marks

The ever rising gap between engineering students' competence & industry expectations



- Knowledge
- ***Skills/Know-how***
- ***Attributes/Behaviors***



- Productivity from day-1
- Contribute to innovation
- Help build a new culture

Global state of the art in Engineering Education

What is happening to engineering education sector across the world? And will USA be the dominant player?

Study by MIT School of Engineering concludes the following

1. Shift of engineering education leadership from West to emerging Asian 'economic
2. powerhouses' and South America
3. Move towards socially-relevant and outward-facing engineering curricula
4. Emergence of a new generation of leaders in engineering education that delivers integrated
5. Student-centered curricula at scale.

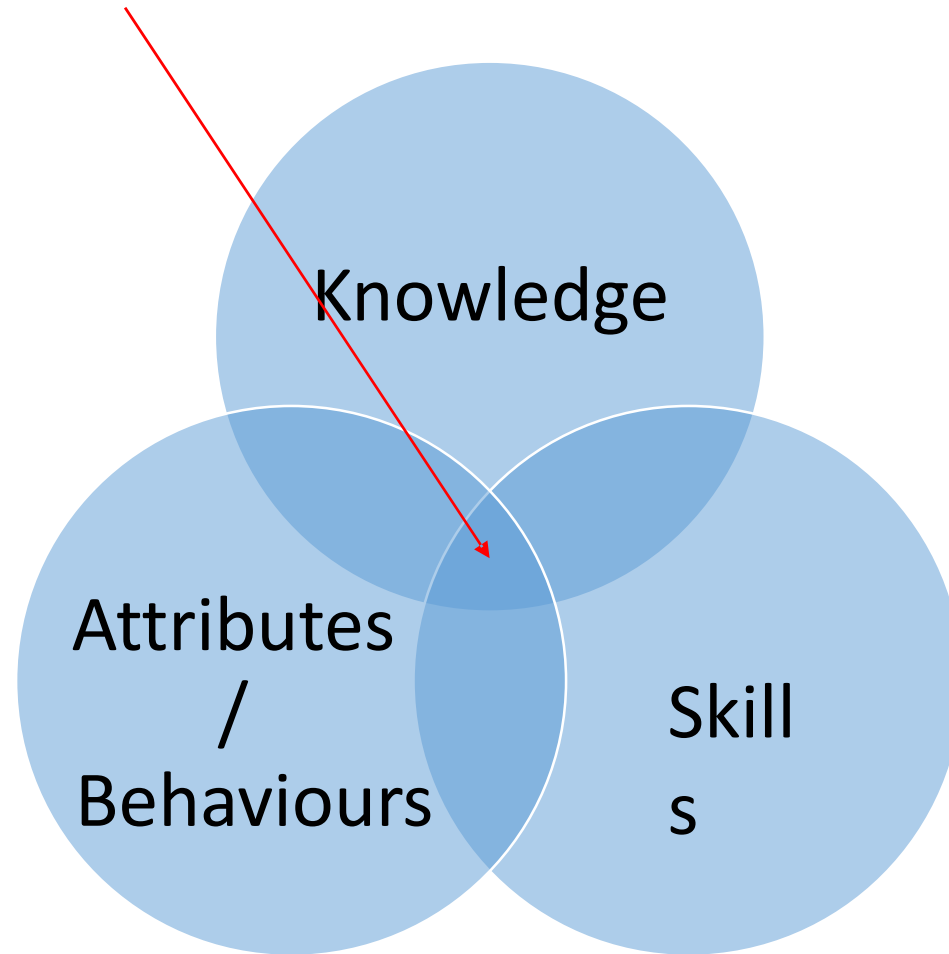
Global state of the art in Engineering Education

Learning how to learn	Making	Discovering	Interpersonal skills
Personal skills and attitudes	Creativity	Systems thinking	Critical and metacognitive thinking
Analytical thinking	Computational thinking	Experimental	Humanistic

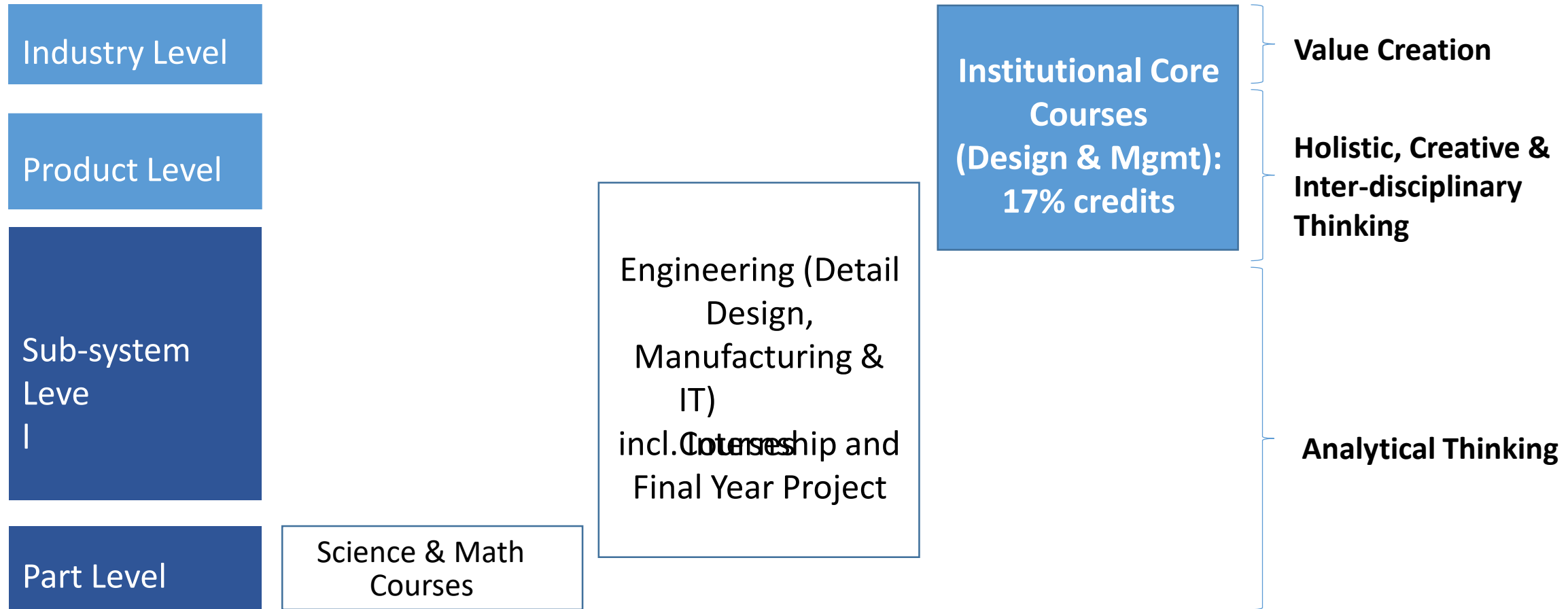
To develop these qualities engineering institutions must approach the overall training very differently, with emphasis on **cross disciplinary, integrative, and problem based learning**



What is competence / outcome of learning?



Product design & entrepreneurship are at a different level compared to engineering & science

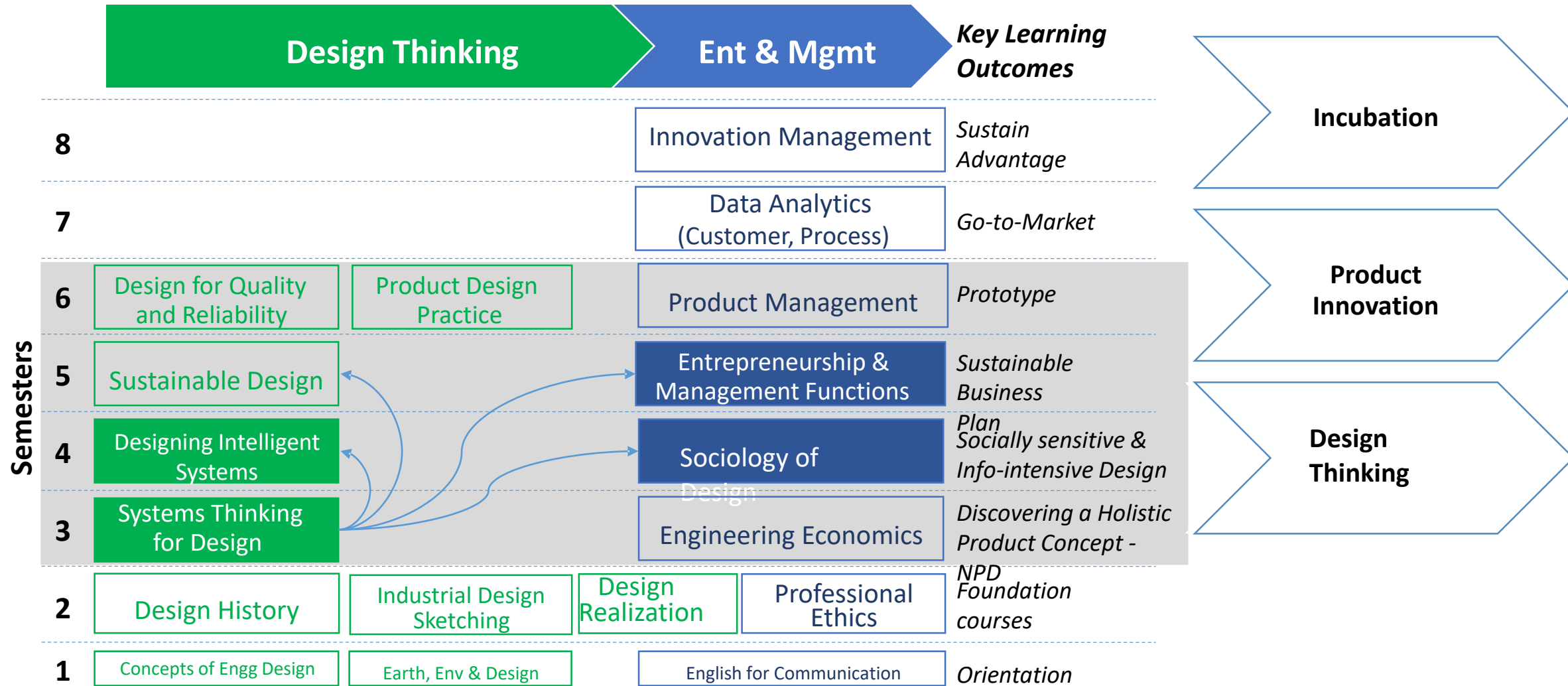


Overall design spine course structure

	Concept design		Embodiment design		Design-Entrep	Verticalized	Project
Semester	Society->Product	Product->Tech	Tech->Product	Product->Society	Product->Economy		
Level-1	1 Foundation						
	2 Sociology of design						PBL
	3	Sys thinking for design					PBL
	4	Smart product design					PBL
	5				Entrep & Mgt		PBL
Level-2*	6.1		Prototyping & Testing				PBL
	6.2		ELE-1			ELE-2	
	6.3						
	7.1			ELE-3			Internship or Pre-incubation
	7.2					ELE-4	
	7.3						
	8.1			ELE-5			Final Project
	8.2				ELE-6		
	8.3						
Total credits	2*3=6	2*3=6	3 6 for D++	6 for D++	3 6 for D++	6 for D++	10+10=20 for D++

- *Level-2 courses will be applicable for students opting for Design++ (Minor) at the end of the 5th semester
- *Level-2 courses will include courses offered in the M.Des program in ODD/Even semester
- *Courses in the 7th semester (ELE-3 and ELE-4) will be online courses

Courses to promote design thinking, product innovation and incubation



Introductory Session

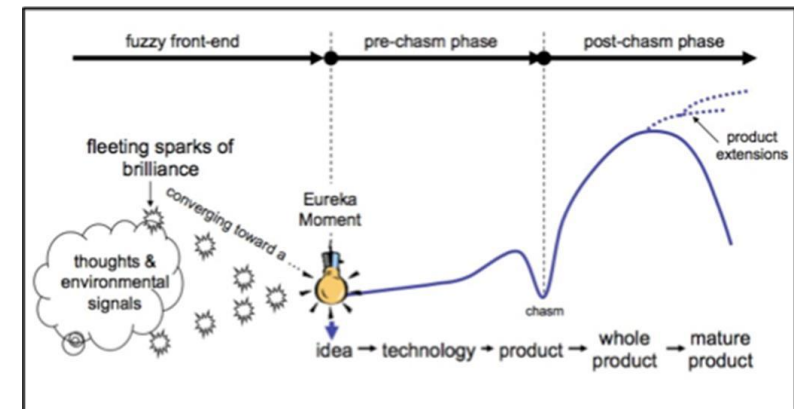
Understanding IIITDM

DS2000: Learning Objectives & Course Structure

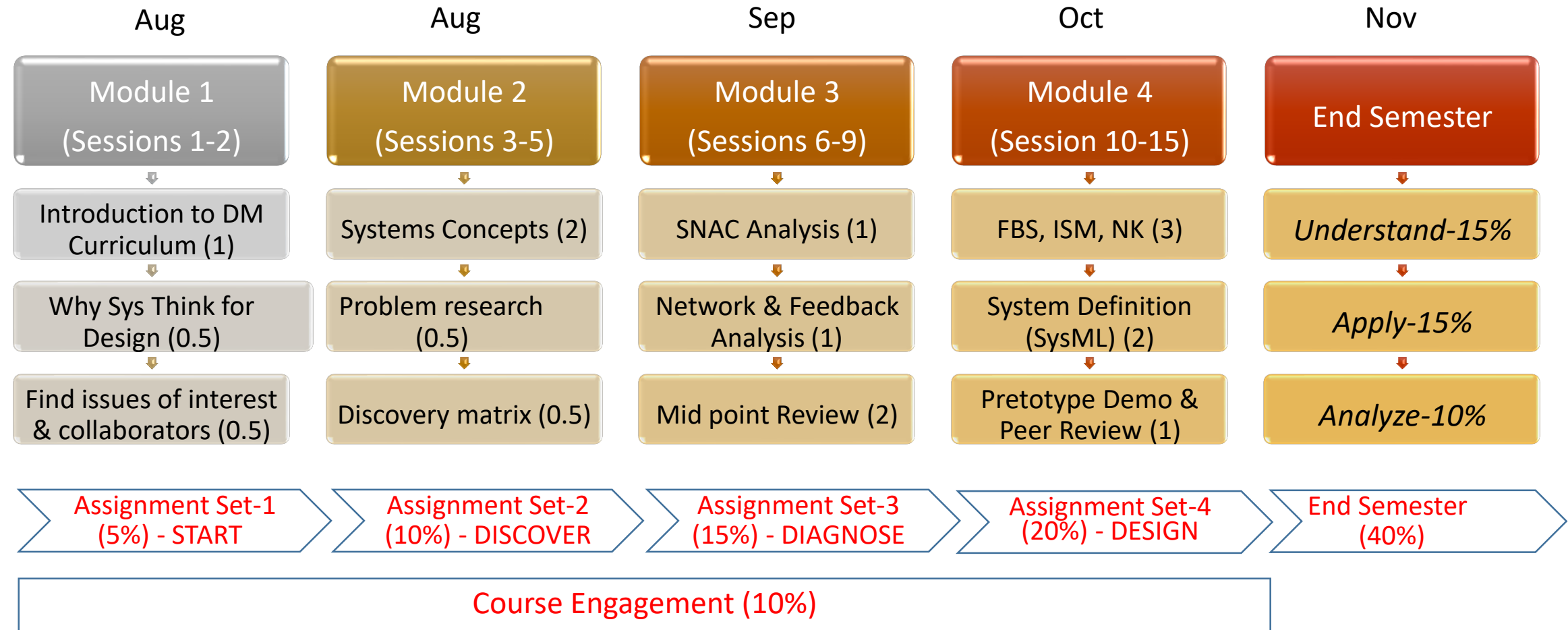


Learning Objectives and Outcomes

- **The objective of this course** is to introduce engineering students to a systemic (holistic and integrative) approach to product design in particular and problem solving in general
 - The focus will be on the issues in the **fuzzy front-end of new product development** that comes much before the detail engineering design phase
- **At the end of the course, you will be able to:**
 - Know how to identify right problems in a domain (opportunity / need identification)
 - Apply frameworks & methods to model function, behavior, structure of a system(s)
 - Model the requirements and a high level product architecture



Session and Assessment Plan



Key References

New Product Design & Engineering Design

1. Chitale, A.K. and Gupta, R.C. (2011), Product design and manufacturing, PHI Learning Private Limited, New Delhi (library)
2. Ulrich Karl, Eppinger Steven and Goyal Anita (2009), Product design and development, Tata McGraw Hill (library)
3. Pahl, G., Beitz, W, Feldhusen, J., Grote, K.H. (2007); Engineering Design: A systematic approach, Third Edition, Springer (library)

Systems thinking & Systems engineering

1. Andrew P. Sage and James E. Armstrong Jr. (2000), Introduction to Systems Engineering, Wiley (library)
2. Alexander Kossiakoff & William N Street (2003), Systems Engineering: Principles and Practice, Wiley Student Edition (library)
3. Hitchins, Derek (2003), Advanced systems thinking, engineering and management, Artech House (library)

Rules of Engagement

- Prepare and come to the class for discussion
 - Videos, course (presentation and reading material) will be shared with you
 - Have A4 sheets (4-5) for classroom work
- Work on topics of interest
 - You research and study outside the class (individually or in groups)
- Document individual and group contributions
- Course engagement includes individual and group participation
 - Attendance (2 hr session), classroom discussion, FAQs, Timely submission

Self-reflection: Why am I doing What I am doing?

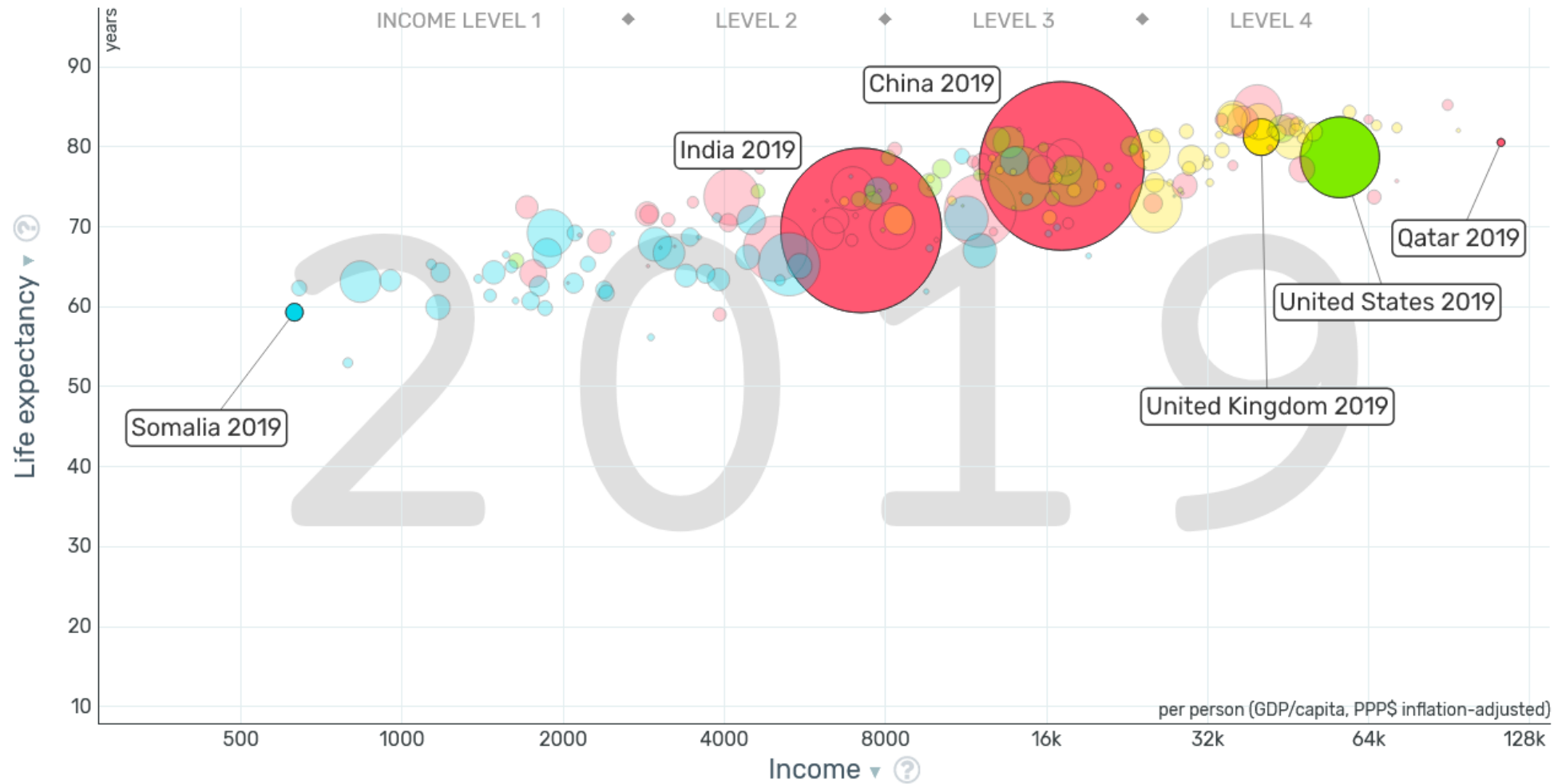
There is a lot of information in the ordinary everyday activities. Self-reflection can help you notice that

It is a practice that can differentiate between 20 years of experience and 1 year experience repeated 20 times

Exercise 1.4: Take the first step in self-reflection (20 min)

- Write a note reflecting on
 - Who you are? Where are you coming from (roots/ideology)?
 - What inspires or frustrates you?
 - Why engineering?

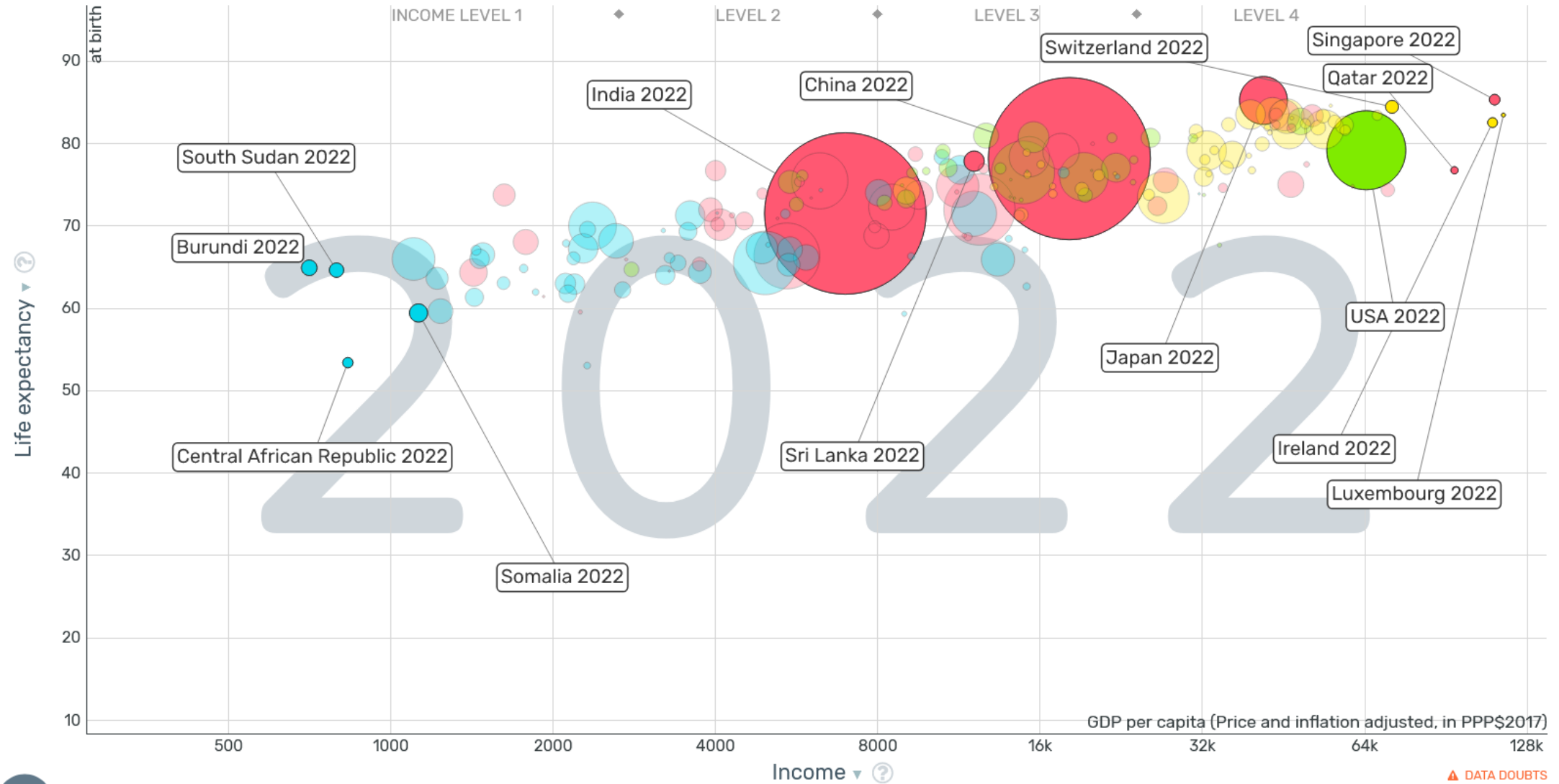
World income levels 2019



Infographic from “www.gapminder.org”



World income levels 2022



World income levels 2022

Population by income (%)

- Asia: 4.64B people
- Africa: 1.42B
- The Americas: 1.03B
- Europe: 845M

Add a place

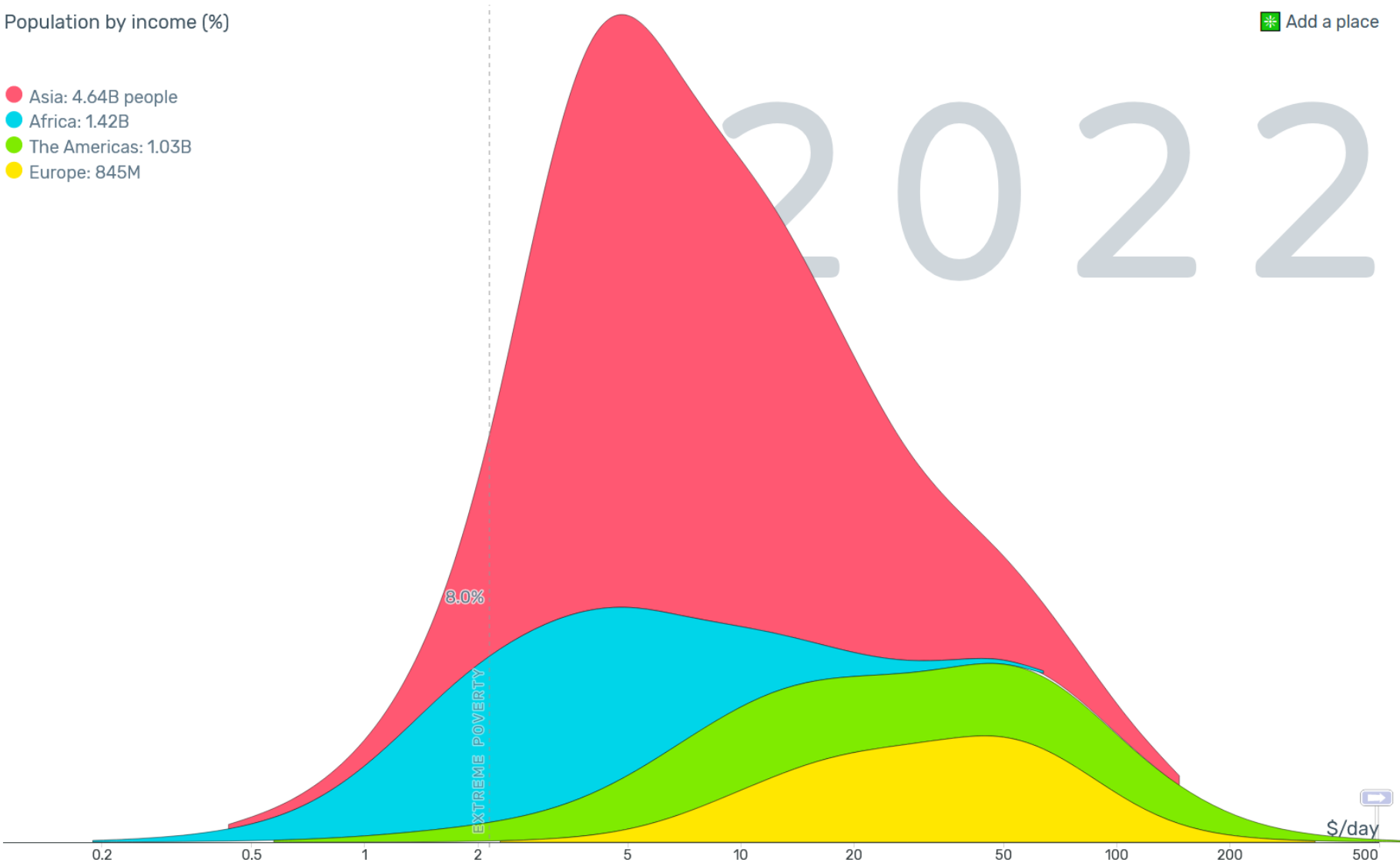


Color World in 4 Regions



Select Search...

- ☒ The Americas
- ☒ Europe
- ☒ Asia
- ☒ Africa



DESELECT

☐ Show photos from [Dollar Street](#)

☒ PERCENT ☐ OPTIONS ☐ PRESENT ☐ RESTORE

Assignment

1. Watch the following video on by Hans Rosling - “The best stats you've ever seen”

<https://youtu.be/hVimVzgtD6w>

2. Follow and subscribe to the following youtube channels

I. Tim Hunkin – Engineer and Designer - <https://www.youtube.com/user/timhunkin1>

II. Economics Explained - <https://www.youtube.com/user/JitaLounge>