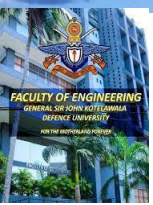
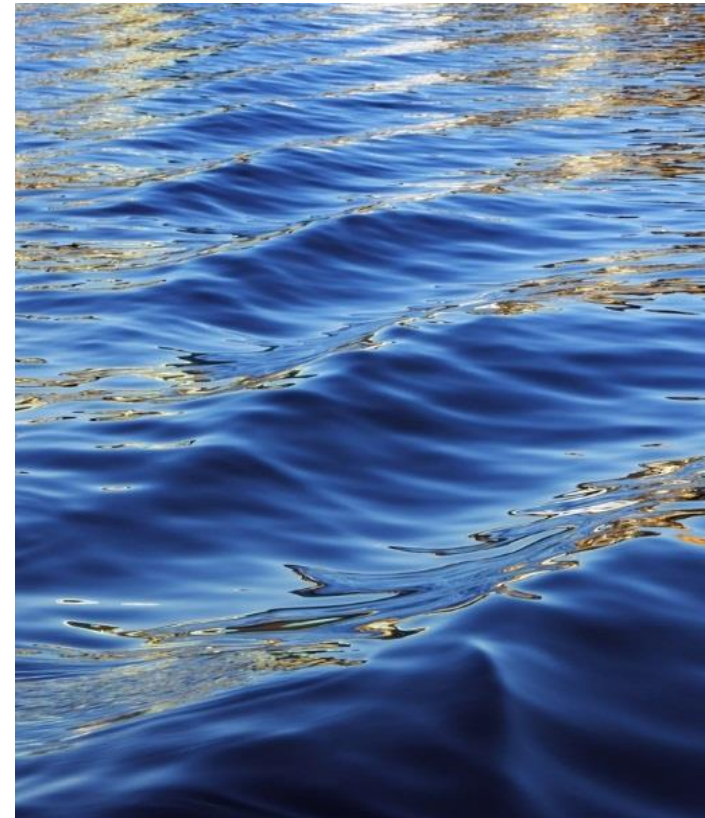


# Ideation Methods

ET-3153



# Outcomes

At the end of this lecture, you will be able to:

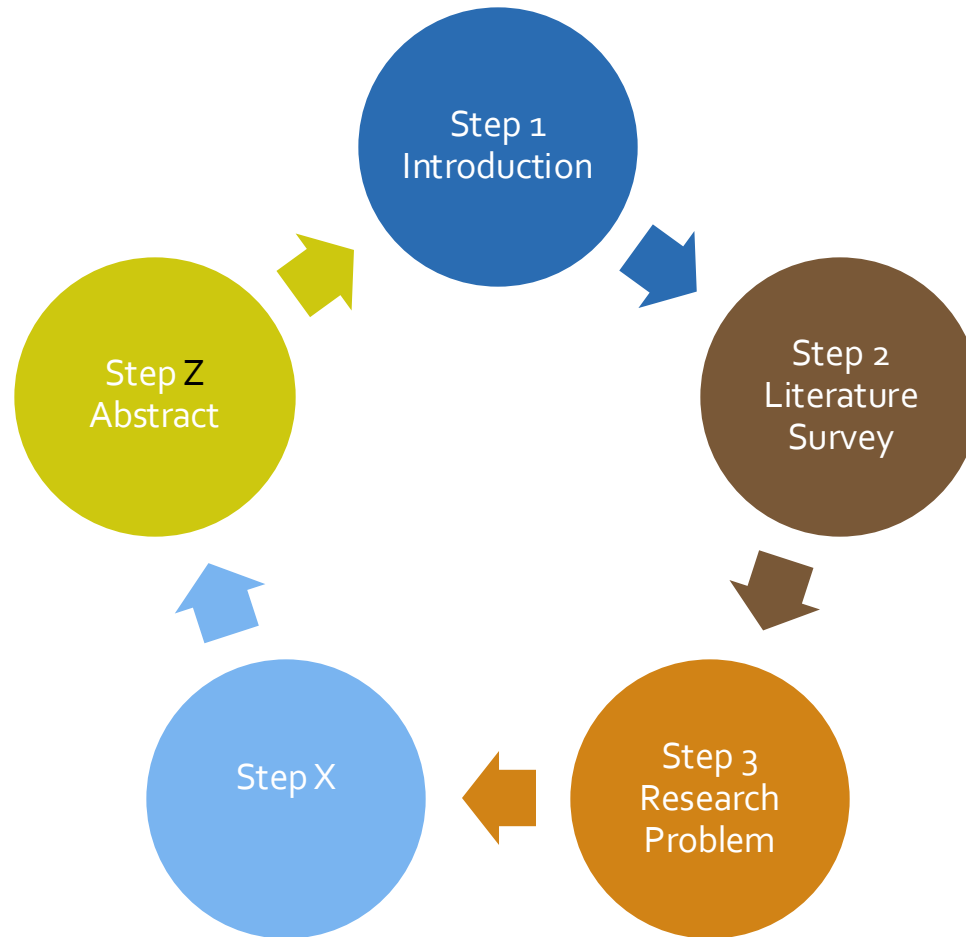
- Ideate with *6-3-5 Brainwriting Method*.
- Build on ideas of colleagues.
- Introduced to *Function Analysis*.
- Generate ideas in an Analytical and Systematic manner using *Morphological Method* to improve your design.
- Validate your design using *Concept Fan Method*.
- Introduced to *Mind Mapping*.
- Introduced to useful *Online Tools*.

# Module Descriptor

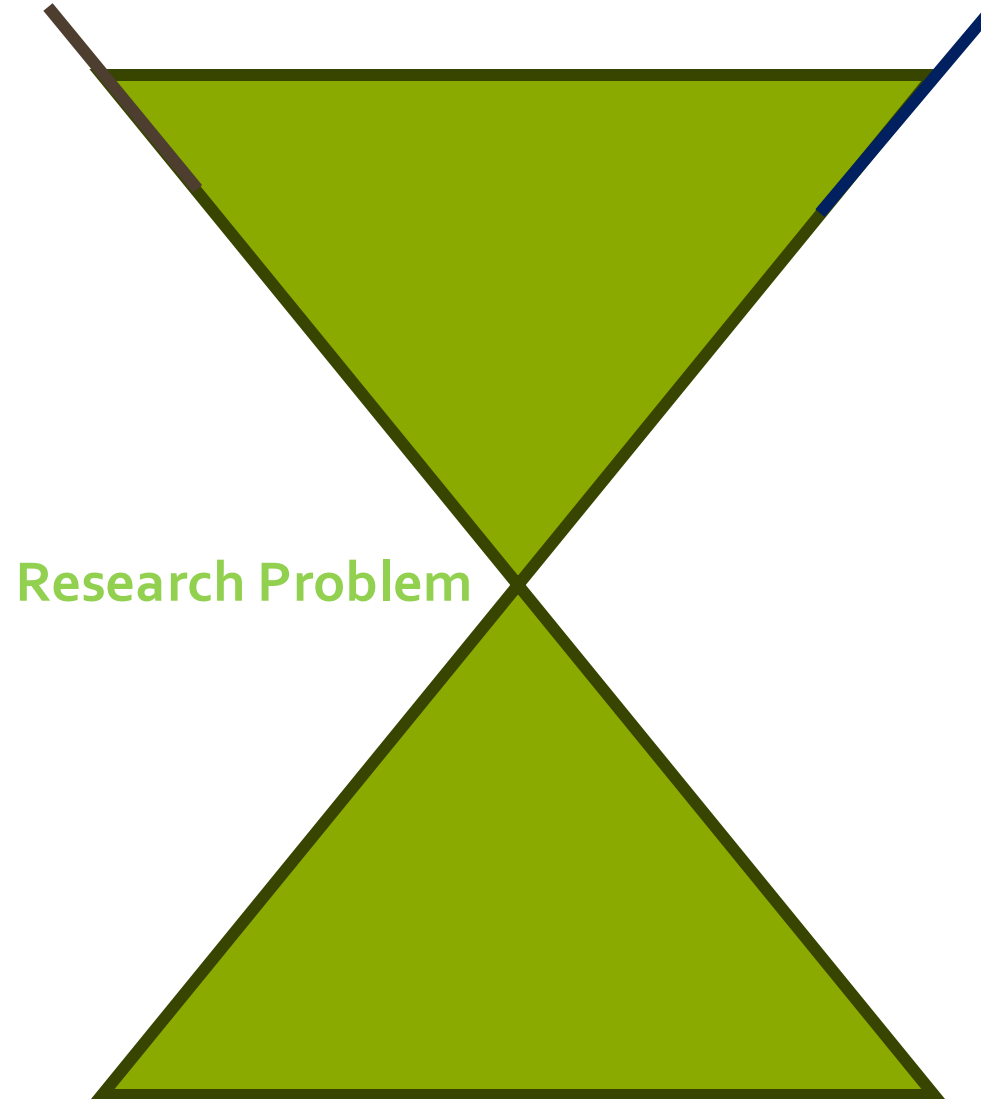
# Research

- A **systematic inquiry**, that helps make the sense of the world.

# Contents



# Research Process



Research Problem





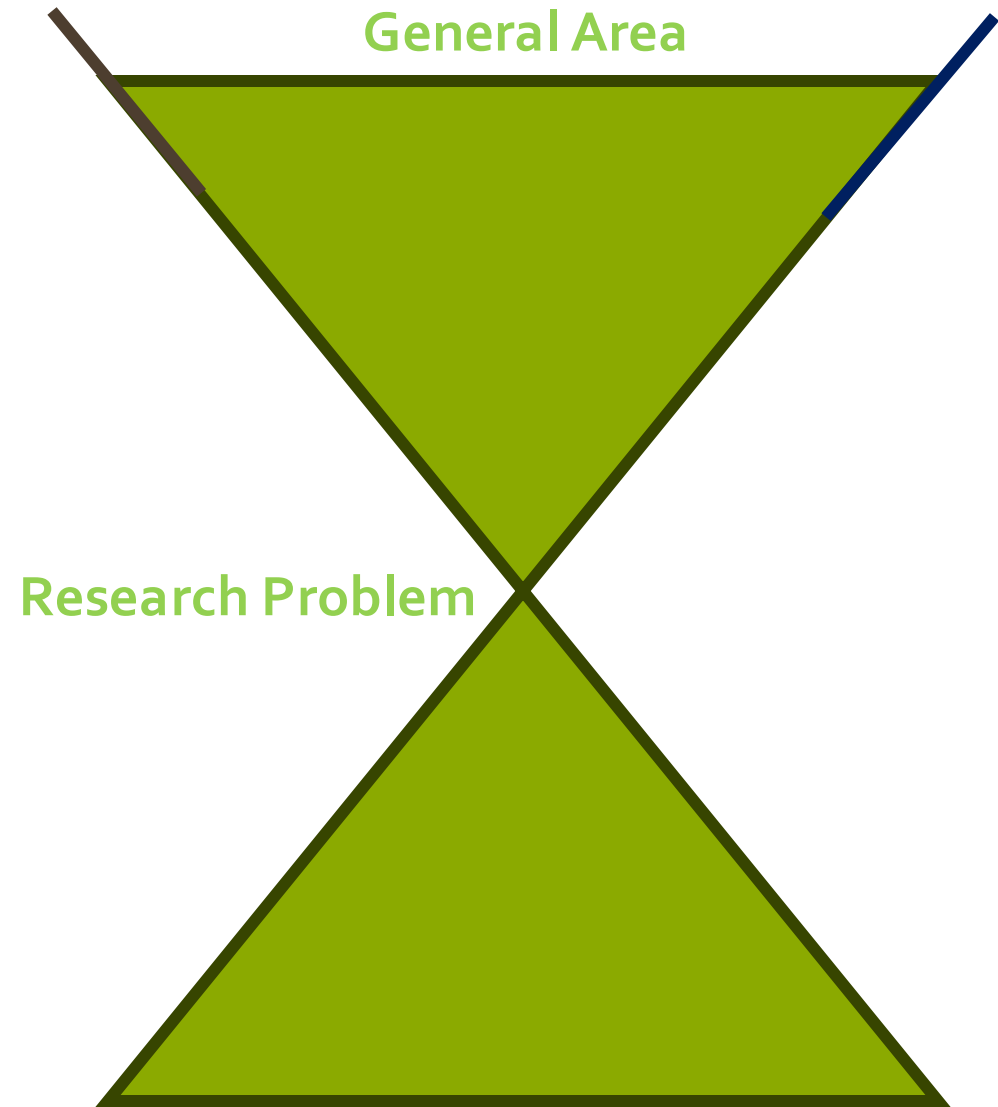
# General area

Specific Area

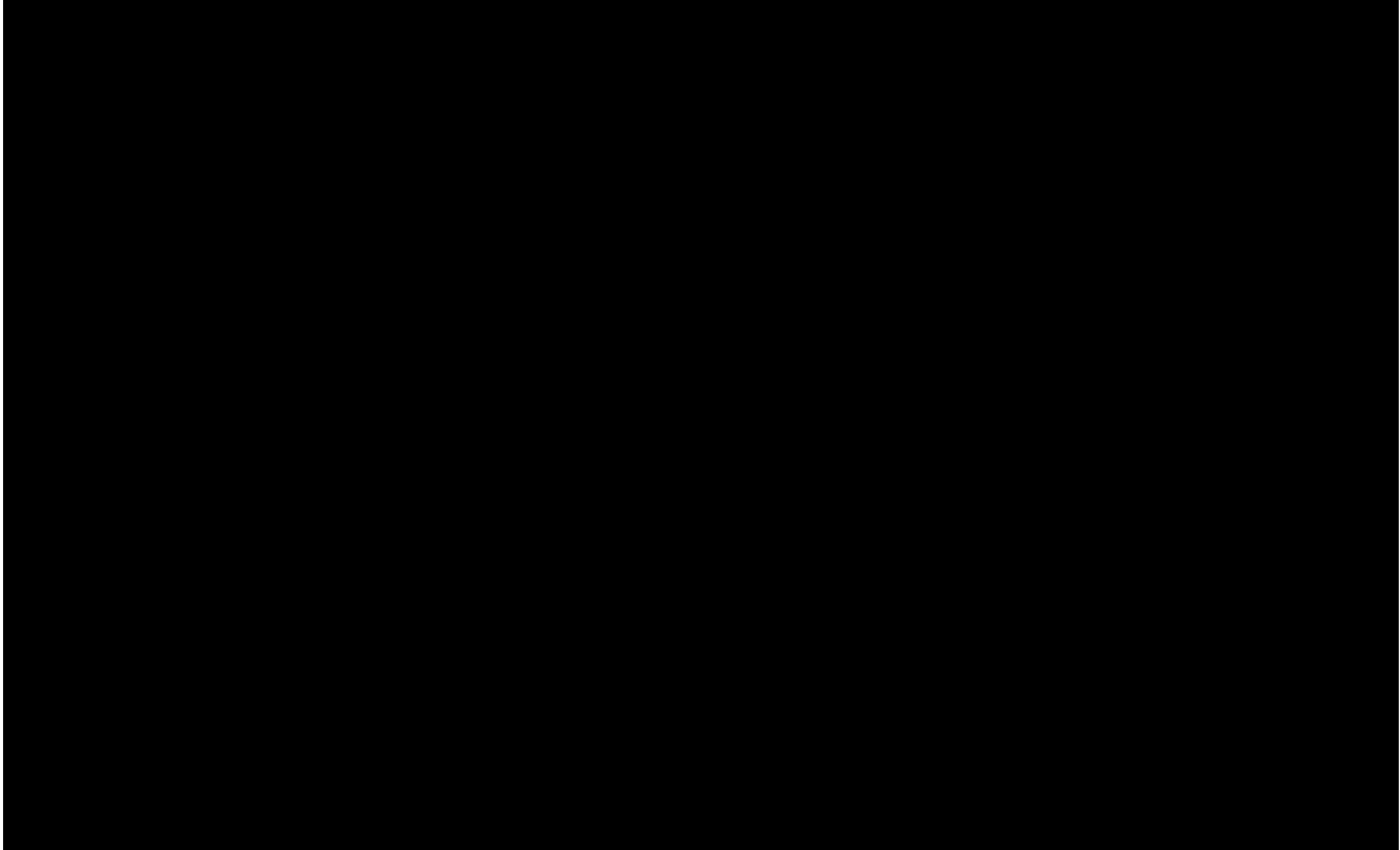


# General Area

- Favorite
- Inspiring
- Intriguing
- Curious
- Burning
- National level
- Global level





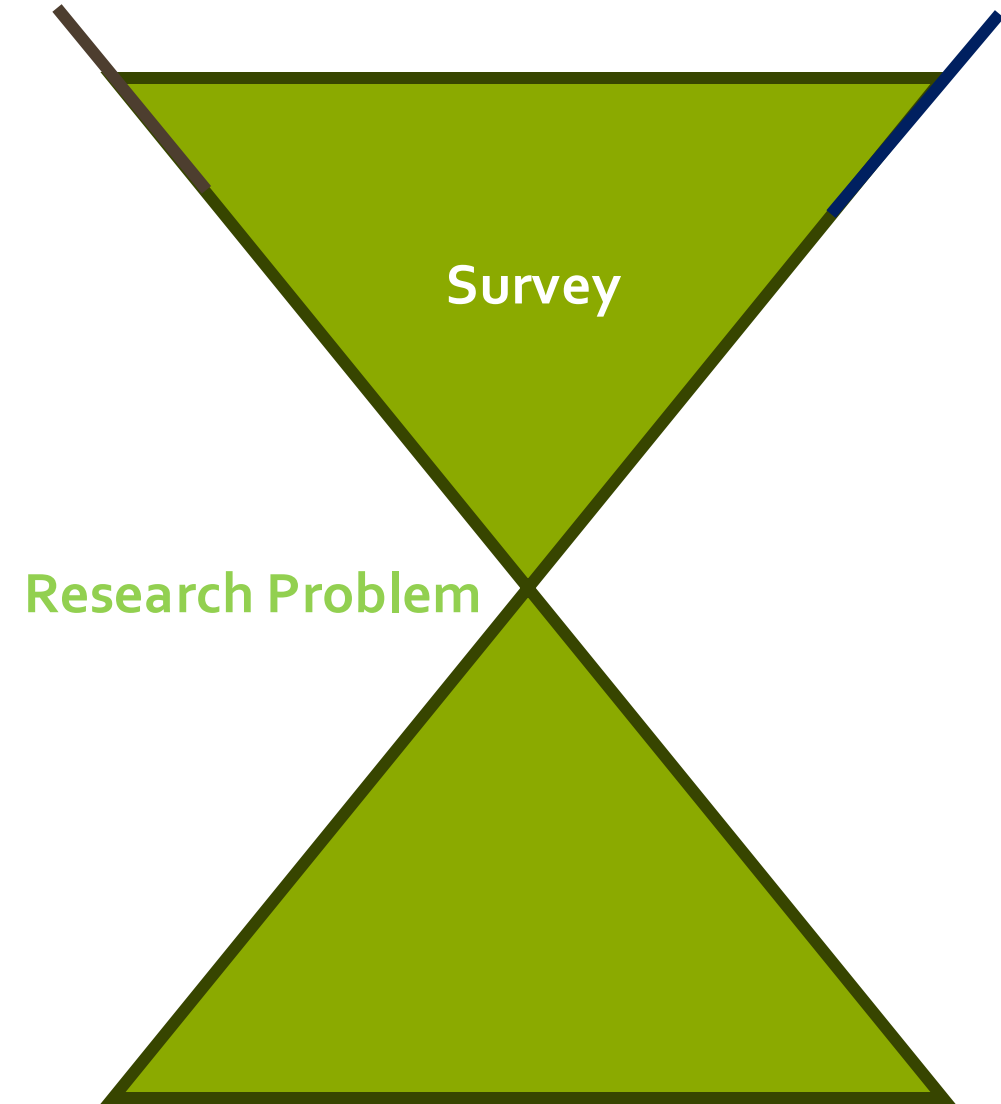
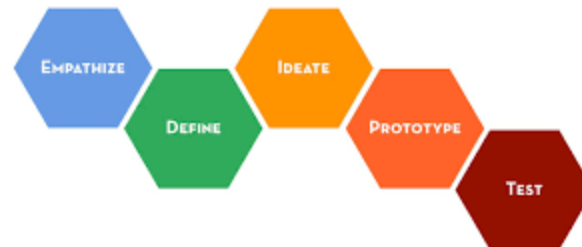




# Specific Problem

- Literature Survey
- Patent Search
- Product Survey
- Professional Problem

- Design Thinking



# 6-3-5-Method

# 6-3-5-Method

- Six people each receive a copy of the template and write three ideas in the first row. Then the
- sheet is passed clockwise, and the next person builds on the previous person's ideas.
- This process is repeated five times. If you don't have any ideas, leave the cell blank.
- You have three minutes per round. After 15 minutes, you then have six tables with 18 ideas each = 108 ideas.
- Note: The method also works in a 4-3-3 or 3-3-2 model.

## 6-3-5 Method Canvas

Problem:

	Solution/Idea 1	Solution/Idea 2	Solution/Idea 3
Student 1			
Student 2			
Student 3			
Student 4			
Student 5			
Student 6			

# 6-3-5-Method

Problem Statement:			
	Idea #1	Idea #2	Idea #3
Person A	Person A writes an idea here...	...and another idea here	...and another here.
Person B	Person B writes their idea here, perhaps a new idea...	...or one which builds from an earlier idea	... or a combination of both ideas
Person C	Person C contributes here, adding their ideas in this row...	... which build on any ideas on this page ...	... or may be entirely new

# Functional Analysis - A Brief Introduction



# Functional Analysis

- The Functional Analysis allows:
  - identifying the **physical components**, the so-called building blocks, which constitute the future product, and
  - how they are **interrelated to build up the functional architecture** of the future product.

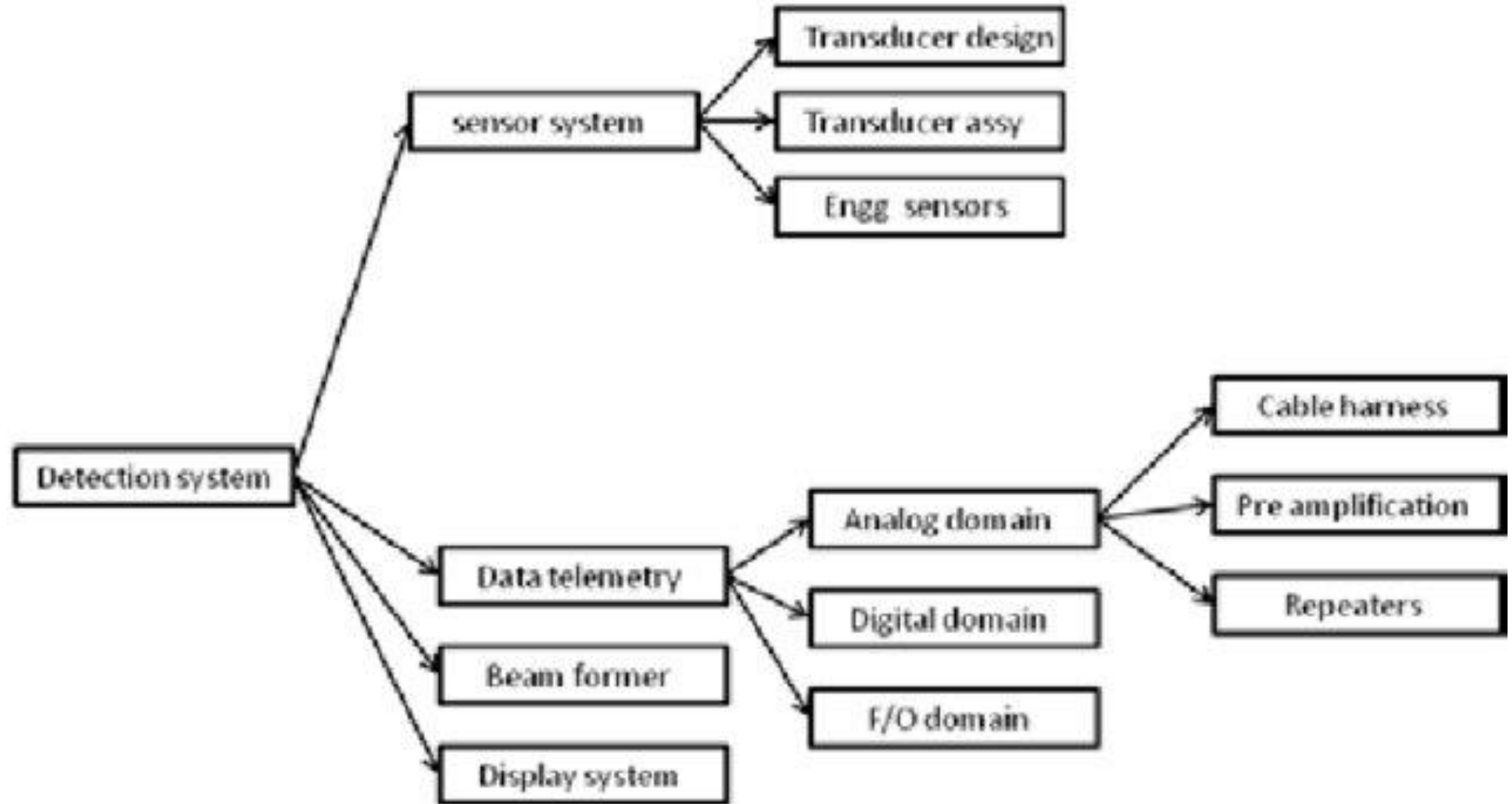
# Functional Analysis

- Functional Analysis as the systematic process of,
  - identifying,
  - describing, and
  - relating the functions a system has to be able to perform,
  - in order to be successful,
  - but does not consider it as a design tool to address how functions will be performed,  
i.e. to map functions to physical components.

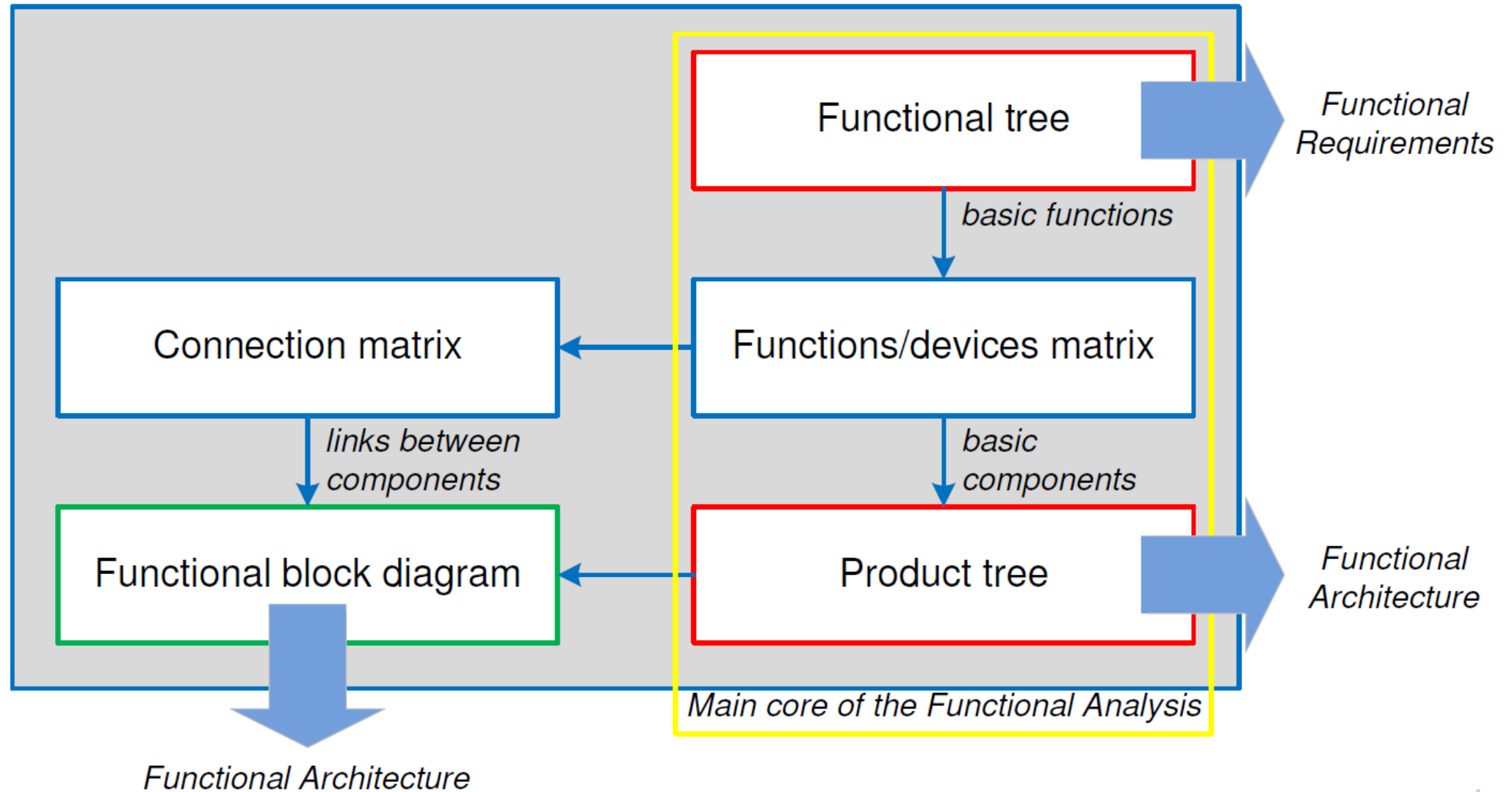
# Functional Analysis

- In conceptual design Functional Analysis can be applied at different levels:
  - **subsystem** level (like the avionic subsystem of an aircraft, consisting of various pieces of equipment),
  - **system** (like a satellite consisting of various systems) and
  - **system of systems** level (like a Moon base, consisting of various systems).
- According to the considered level, the physical components or building blocks, which make up the future product, are therefore equipment, subsystems or systems.

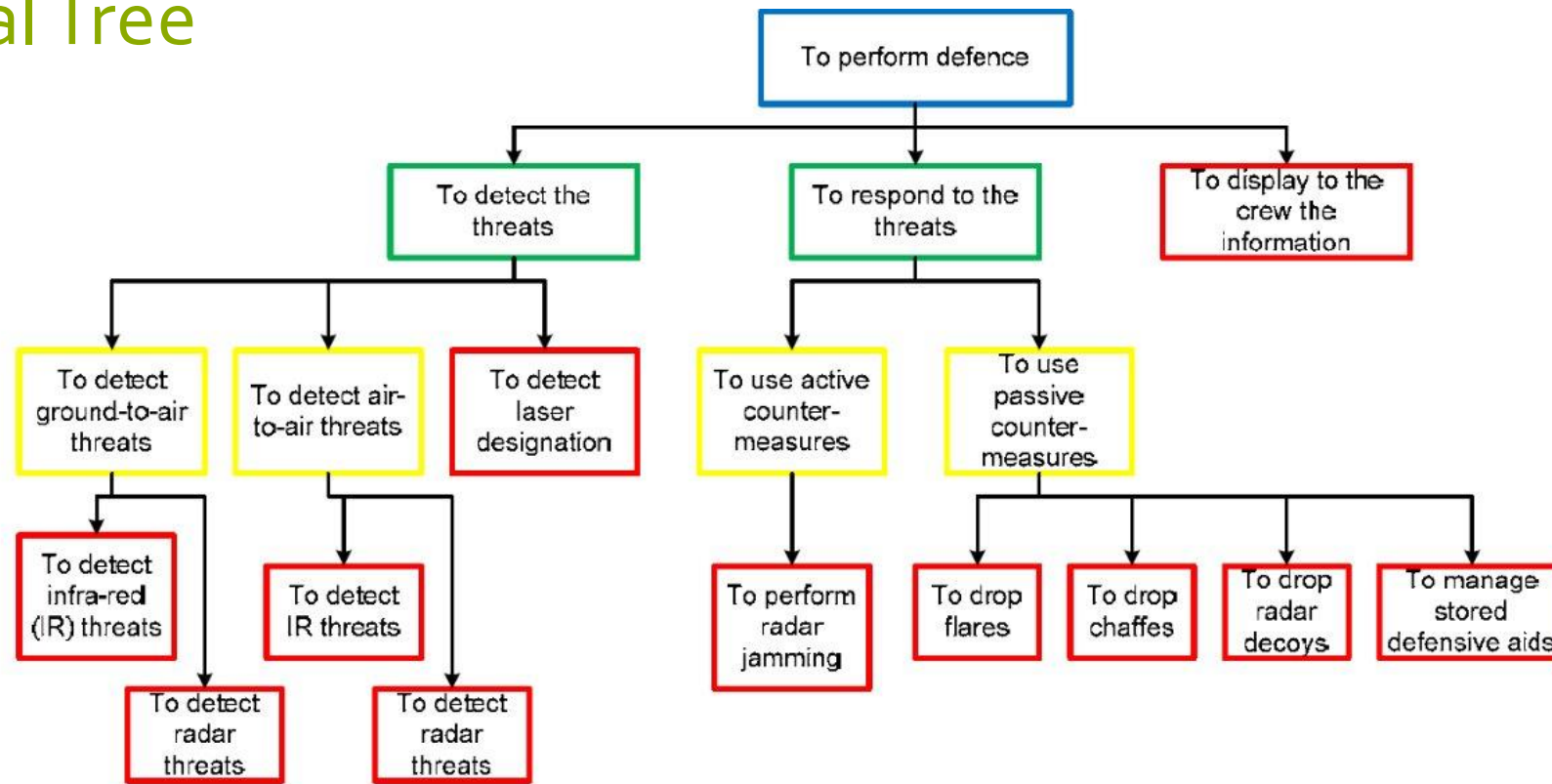
# Functional Analysis - An Example



# Functional Analysis - Work Flow



# Functional Tree



- The functional tree allows **splitting the higher level functions**, which stem from the mission objectives/top level system requirements, **into lower level functions** and eventually it allows **identifying the basic functions** that have to be performed by the future product.
- Through the functional view we look at a new product asking ourselves “**what does it do?**”
- Each function shall be expressed by means of **verb** and **noun**.
- In case functions **cannot be decomposed any further**, they shall be reported at the bottom of the tree as basic functions.

# Functions/ Devices Matrix

- The functions components matrix is therefore used to **map functions to physical components**.
- Built simply by matching the bottom of the functional tree, consisting of **all basic functions**, with one column of components able to perform those functions.
- Starting from the column containing the first basic function under consideration, the **component able to perform that function can be defined** by simply answering the question: "**which component is able to perform this function?**"
- The same process applies to all basic functions. Starting from the analysis of the first basic function, new components progressively fill in the column of devices. Eventually **all basic components are determined**.
- With the functions/devices matrix we now know the **basic components or building blocks, which constitute the future product**.
- By simply grouping together the basic components, the product or physical tree of the new product can be generated.

		Basic functions								
		To detect infra-red (IR) threats	To detect radar threats	To detect laser aiming	To perform radar jamming	To drop flares	To drop chaff	To drop radar decoys	To manage stored defensive aids	To display to the crew the information
Basic devices	Missile warning receiver	X								
	Infra-red (IR) warning system	X								
	Radar warning receiver		X							
	Laser warning system			X						
	Jammer decoy dispenser				X			X	X	
	Jamming system				X					
	Chaff/flares dispenser					X	X		X	
	Store management system								X	
	Multi Function Display (MFD)									X

# Connection Matrix

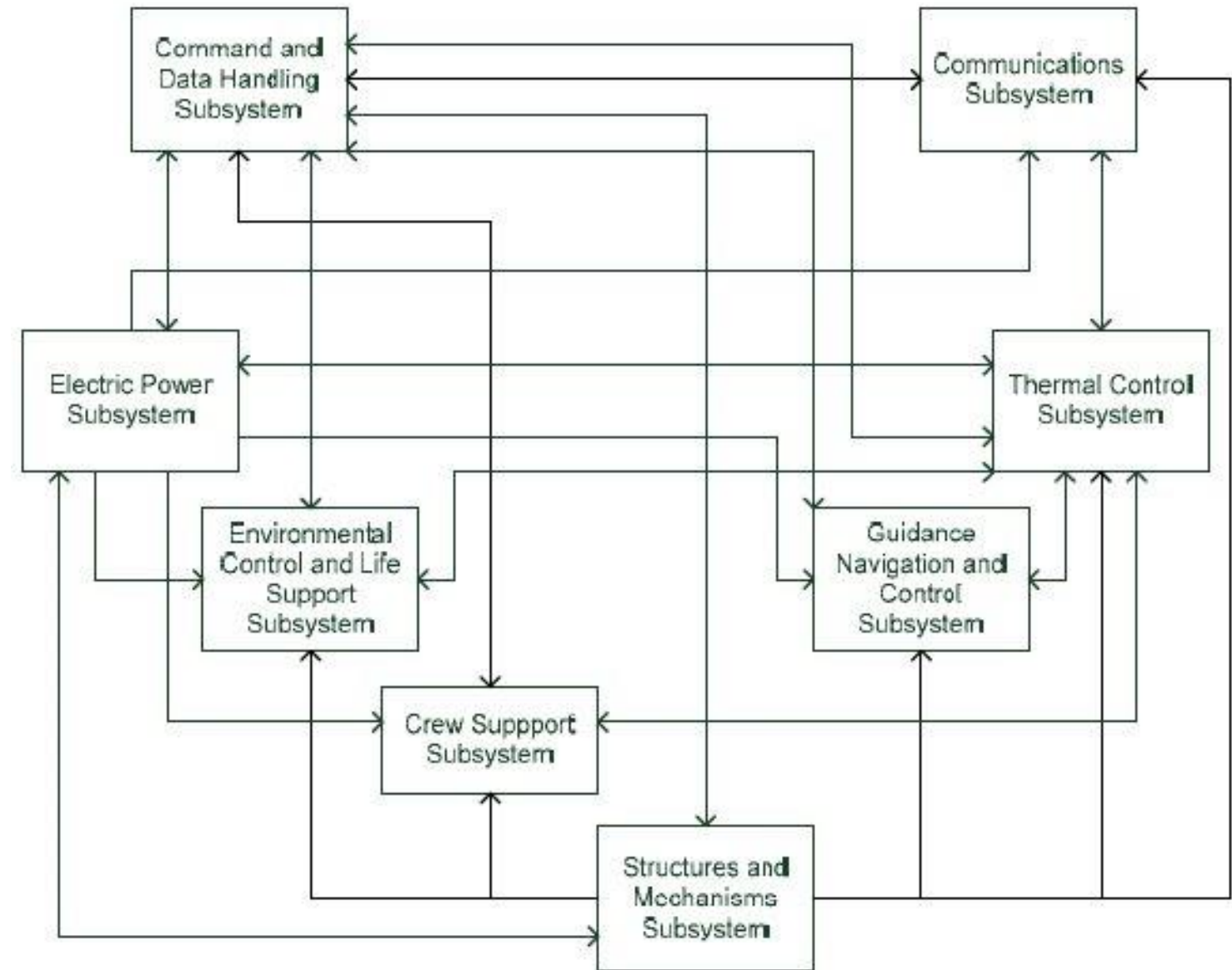
- Once the basic components have been identified, the **links between the various components within the system** can be determined.
- Starting from the first row and then proceeding down the column of basic devices, **all components have to be analyzed**, in order to **understand whether or not there are connections between them**.
- In case two components have a connection because, for instance, they are requested to exchange information, then the box where the two components intersects must be ticked.

Basic devices	Missile warning receiver									
	Infra Red (IR) warning system									
	Radar warning receiver									
	Laser warning system		X					X		
	Jammer decoy dispenser			X		X			X	
	Jamming system				X		X			X
	Chaff/flares dispenser					X		X		
	Store management system	X								
	Multi Function Display (MFD)		X							



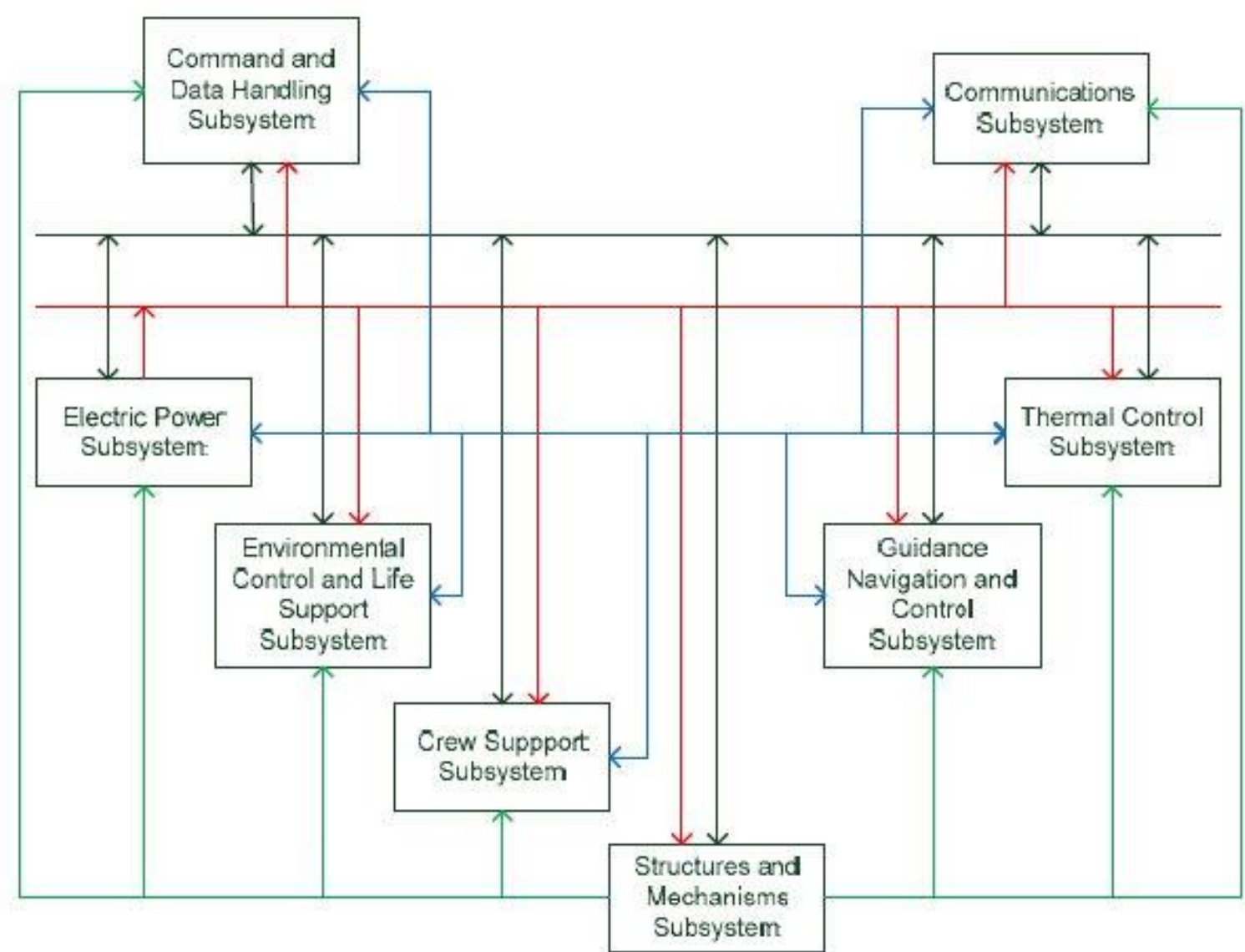
# Functional Block Diagram

- In the functional block diagram, where building blocks, that need to be **connected**, are linked through point-to-point connections.
- These connections are **arrows and not just simple lines**, the functional block diagram provides the reader with additional information, if compared to the connection matrix, as it **highlights not merely connections but where these connections are pointing to**, i.e. if they are half duplex or full duplex connections.
- Referring to a functional block diagram, it is therefore possible to **understand** that, for instance, **sensors are transmitting information to displays and not viceversa**.



# Physical Block Diagram

- Neither the connection matrix, nor the functional block diagram is said about the **nature of the connections**, which may be, for instance, power, signal or fluid lines.
- This information is instead provided by the physical block diagram, which may be considered as **complementary to the functional block diagram**.
- Power line supplies the various building blocks with the necessary power.
- The signal lines, unlike the **functional block diagram where there are point-to-point connections**, in the **physical block diagram** there is a **main bus to transmit commands and receive feedbacks to/from the various subsystems**.
- The building blocks that need an active cooling interface to dissipate heat are connected by a ducting fluid line with the Thermal Control Subsystem.



# Morphological Matrix

# Morphological Matrix

- Functions of the product are taken as a starting point.
- The various functions and subfunctions of a product can be established through a function analysis.
- These solutions will form the components in the morphological chart.
- The morphological method thus yields a matrix of functions and components.
- Possible components are listed on the basis of their functions.
- The components are concrete and specific, specifying the elements that belong to a category (i.e. parameter).

# Building a Morphological Matrix

- How to Morphological Chart

- formulate the problem

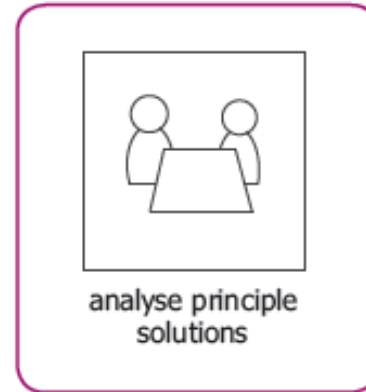
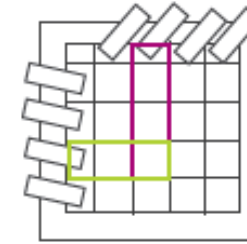
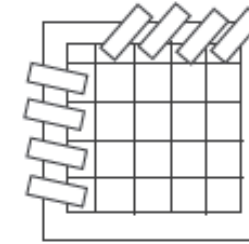
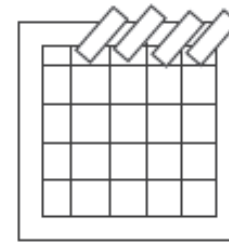
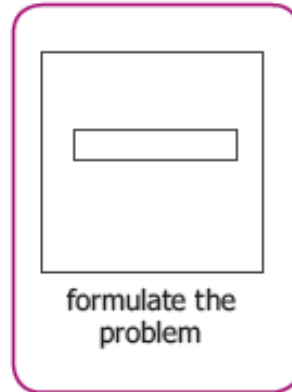
- identify parameters

- create matrix with parameters in columns

- fill rows with components

- create principle solutions

- analyse principle solutions



# Morphological Matrix

ET3153



















Individual Design Project

Morphological Method Canvas

Equipment:

Function/Attribute	Solution/Method 1	Solution/Method 2	Solution/Method 3

# Morphological Matrix

Eyes	 off	 look downwards	 flash	 animation	 turn of
Screen	 text "follow me!"	 route to next stop	 direction of next stop	 picture of next stop	
Pointer	 Straight up	 towards visitors	 in rest	 to next location	 backwards
Body movement	 none	 little to attract attention	 back and forth	 sideways back and forth	

Daphne E. Karreman, Geke D. S. Ludden, Vanessa Evers, "Beyond R2D2: Designing Multimodal Interaction Behavior for Robot-specific Morphology," ACM Transactions on Human-Robot Interaction, Vol. 8, Issue.3, Article No.: 18, pp 1–32, <https://doi.org/10.1145/3331144>.



# Concept Solution - An Example

Morphological Table			Multiple solutions			
			1	2	3	4
Functions / Tasks	Auto detection & Alert	1	Use Dunking sonar [7]	Towed array & hull sonar [9]	Use towed array sonar & manoeuvre [8]	Non acoustic methods [6]
	Auto classification	2	Use magnetic signature [7]	Use Spectral data for classification [9]	Use satellite data to process movement underwater. [6]	Use Target parameters [8]
	Counter measure	3	Acoustic countermeasure [9]	Silence Own machinery [6]	Use acoustic False target [7]	Use noise makers [8]
	Escape measures	4	Move at flank speeds [8]	Escape geometry to be worked out [9]	Use a second platform to confuse [6]	Silence own ship completely.[5]

Concept solution 2  
 S1,2-S2,2-S3,1-S4,2



# SCAMPER Method

## SCAMPER Method Canvas

Equipment/Problem:

Substitute	Combine	Adapt	Modify	Put to Another Use	Eliminate	Reverse
Replace whole/part or concept with something else.	Unite. What? Who? Ideas? Materials?	Adjust to a new purpose? reshape? tune up?	Change the color, sound, motion, form, size. Make it larger, stronger, thicker, higher, longer. Make it smaller, slower.	Change when, where, location, time, or how to use it.	Omit, get rid of, cut out, simplify, weed out.	Change the order, sequence, pattern, layout, plan, scheme, regroup, redistribute.

# SCAMPER



**S**

Introduce a range of plant-based protein options, catering to the growing demand for vegetarian and vegan alternatives.

**C**

Introduce the concept of "All-Day Breakfast," providing customers with a flexible dining experience.

**A**

Implement mobile ordering and payment systems.

**M**

Make significant modifications to their Happy Meal offerings by reducing portion sizes and incorporating healthier sides like apple slices and milk.

**P**

Repurpose its drive-thru lanes to serve as designated mobile order pickup points.

**E**

Phase out less popular menu items.

**R**

Introduce self-service kiosks at McDonald's locations that allow customers to customize their orders.

# SCAMPER



S

Introduce dairy alternatives like almond milk and oat milk, catering to the growing demand for non-dairy options.

C

Combine the concept of loyalty programs with mobile ordering through the Starbucks Rewards program.

A

Enhance its mobile ordering capabilities, allowing customers to place orders in advance, reducing wait times and catering to the evolving work habits of their clientele.

M

Modify its menu offerings to introduce seasonal and limited-time beverages, creating a sense of urgency and excitement among customers.

P

Repurpose its physical space to create a welcoming environment for remote work and meetings, transforming its locations into versatile spaces for both work and leisure.

E

Discontinue the use of plastic straws in favor of more sustainable alternatives.

R

Rearrange its store layout to facilitate mobile order pickup stations, improving order fulfillment times and enhanced the overall customer experience.



**S**

Explore sustainable materials like recycled polyester and sustainable cotton as a substitute for traditional synthetic fabrics.

**C**

Combine fashion and technology with their collaboration with Parley for the Oceans, resulting in a range of footwear and apparel made from recycled ocean plastic.

**A**

Expand their casual footwear lines, allowing them to tap into the broader trend of comfortable, versatile fashion for everyday wear.

**M**

Modify their shoe designs to incorporate advanced cushioning and support technologies, addressing the evolving needs of athletes and fitness enthusiasts.

**P**

Repurpose their manufacturing waste by incorporating it into the production of new products, reducing waste and demonstrating a commitment to circular economy principles.

**E**

Eliminate hazardous chemicals from their production processes, contributing to safer and more sustainable manufacturing practices.

**R**

Rearrange their supply chain to prioritize local production and reduce carbon emissions associated with transportation.

# Substitute



FJÄLLBERGET chair by The IKEA design



### Air-Umbrella

**1. Basic Structure and Function of the Air-Umbrella**

**2. Controller**

- Power Control On/Off
- Size Control of the air-curtain (large/small)

**3. Length Control Bar**

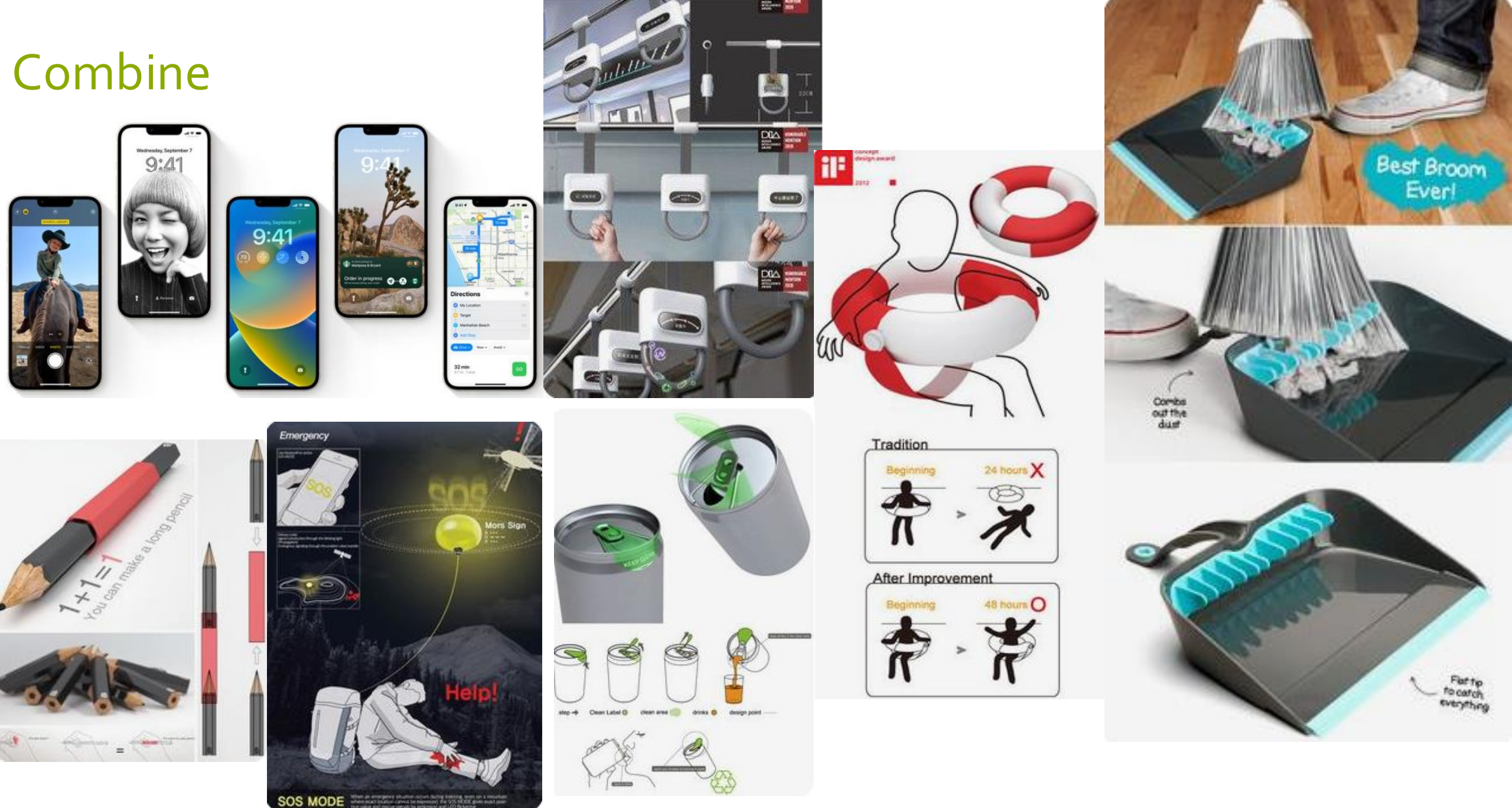
**Convenient**  
The original one is not convenient because of not removing the water drops at once after using them. On the other hand, the Air-Umbrella is more useful to move around or take it since it doesn't have any modules.

**Eco-friendly**  
We have used a plastic bag for the floor not to get wet or stain with the rain drops. But it causes some problems that we could waste a lot of recycled air well as put some tissues out. The Air-Umbrella, however, does not need any plastic bags because it is never wet from the rain at all.

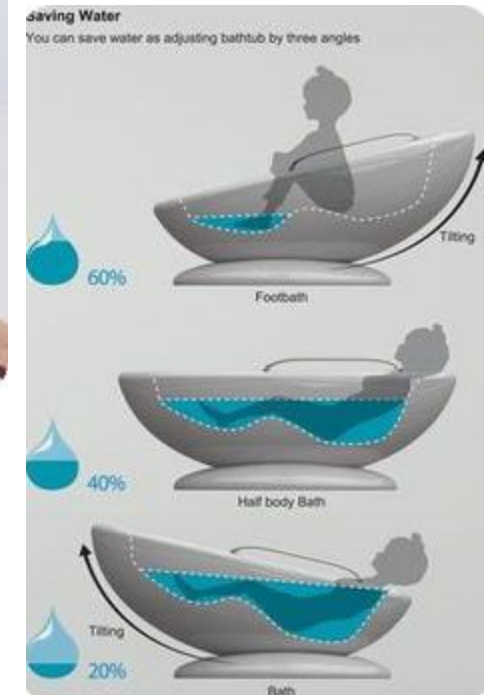
**Portable**  
The Air-Umbrella surpasses the existing umbrella in design. As we control the length of it, we can take it easily everywhere.



# Combine



# Adapt



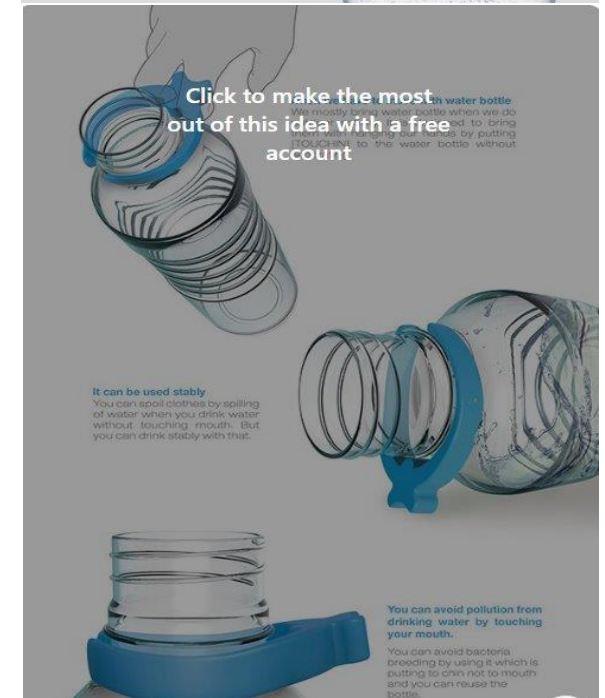
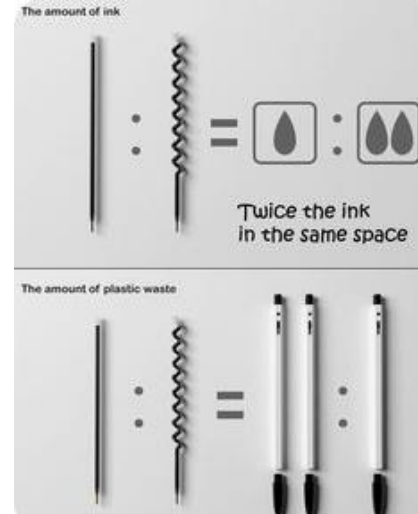




Source: YouTube/ Whistle Design Group

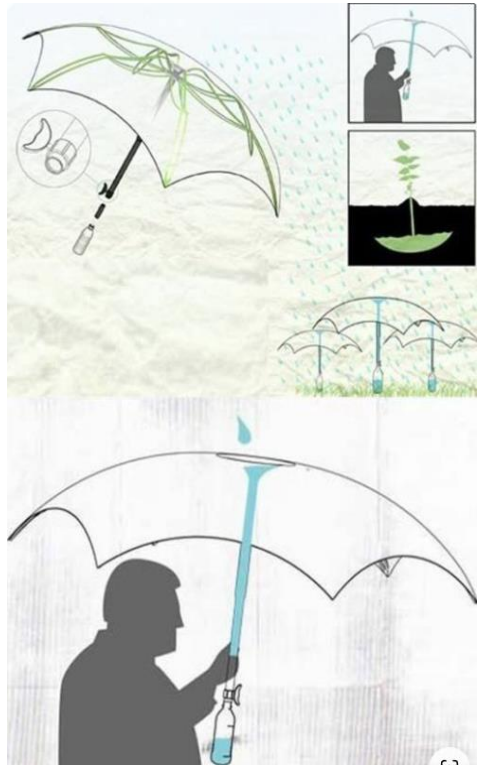
BU T

# Modify





# Put to Another Use



# Eliminate

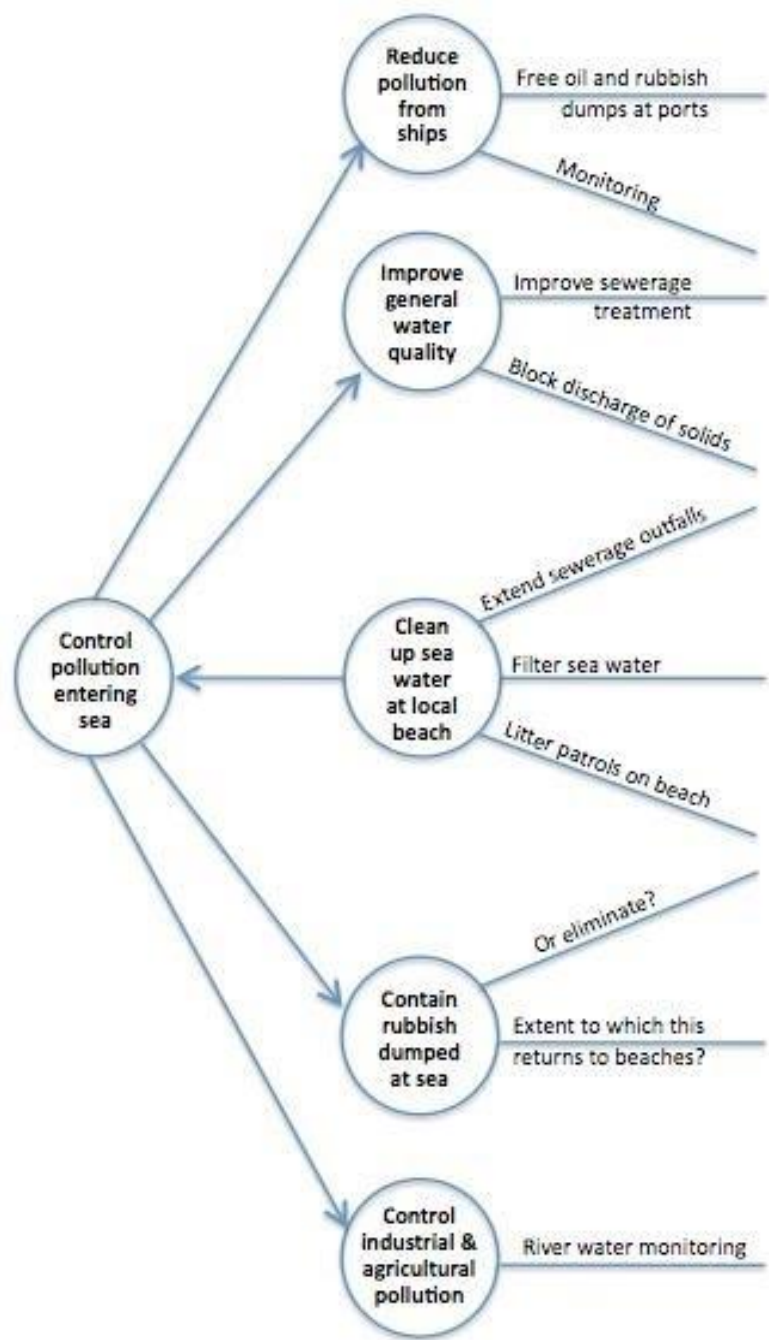




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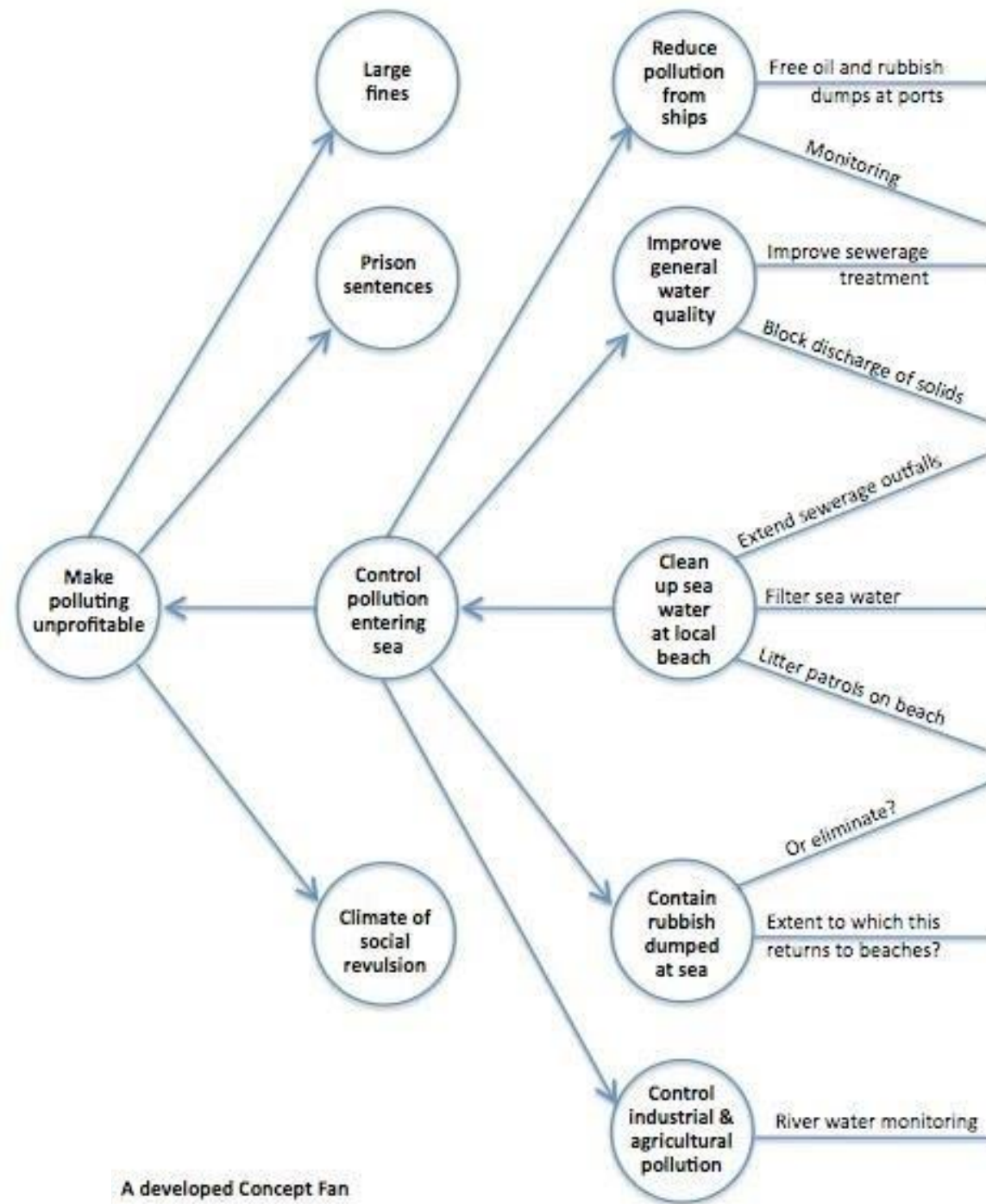
# Concept Fan Method

# Concept Fan





# Concept Fan




A developed Concept Fan



# Literature Survey/ Review

- Pull a chair up to a round-table, and Engage with those notable scholars, researchers and writers, who have addressed your question.
- Where am I in relation to what have already done on the subject.
- The term may sometime be misleading at undergraduate level as we hardly review the literature but situating your work with the literature and identifying gaps and problems with that literature.
- Highlight the Strengths and Weaknesses, some areas need strengthening or elaborating.
- Driven by Research Question

Definitions from [Oxford Languages](#) · [Learn more](#)

 **review**  
/rɪˈvjuː/

*noun*

1. a formal assessment of something with the intention of instituting change if necessary.  
"a comprehensive review of UK defence policy"

Similar: [analysis](#) [evaluation](#) [assessment](#) [appraisal](#) [examination](#) ▼

2. a critical appraisal of a book, play, film, etc. published in a newspaper or magazine.  
"she released her debut solo album to rave reviews"

Similar: [criticism](#) [critique](#) [write-up](#) [notice](#) [assessment](#) [evaluation](#) ▼

*verb*

1. assess (something) formally with the intention of instituting change if necessary.  
"the Home Secretary was called on to review Britain's gun laws"
2. write a critical appraisal of (a book, play, film, etc.) for publication in a newspaper or magazine.  
"I reviewed his first novel"

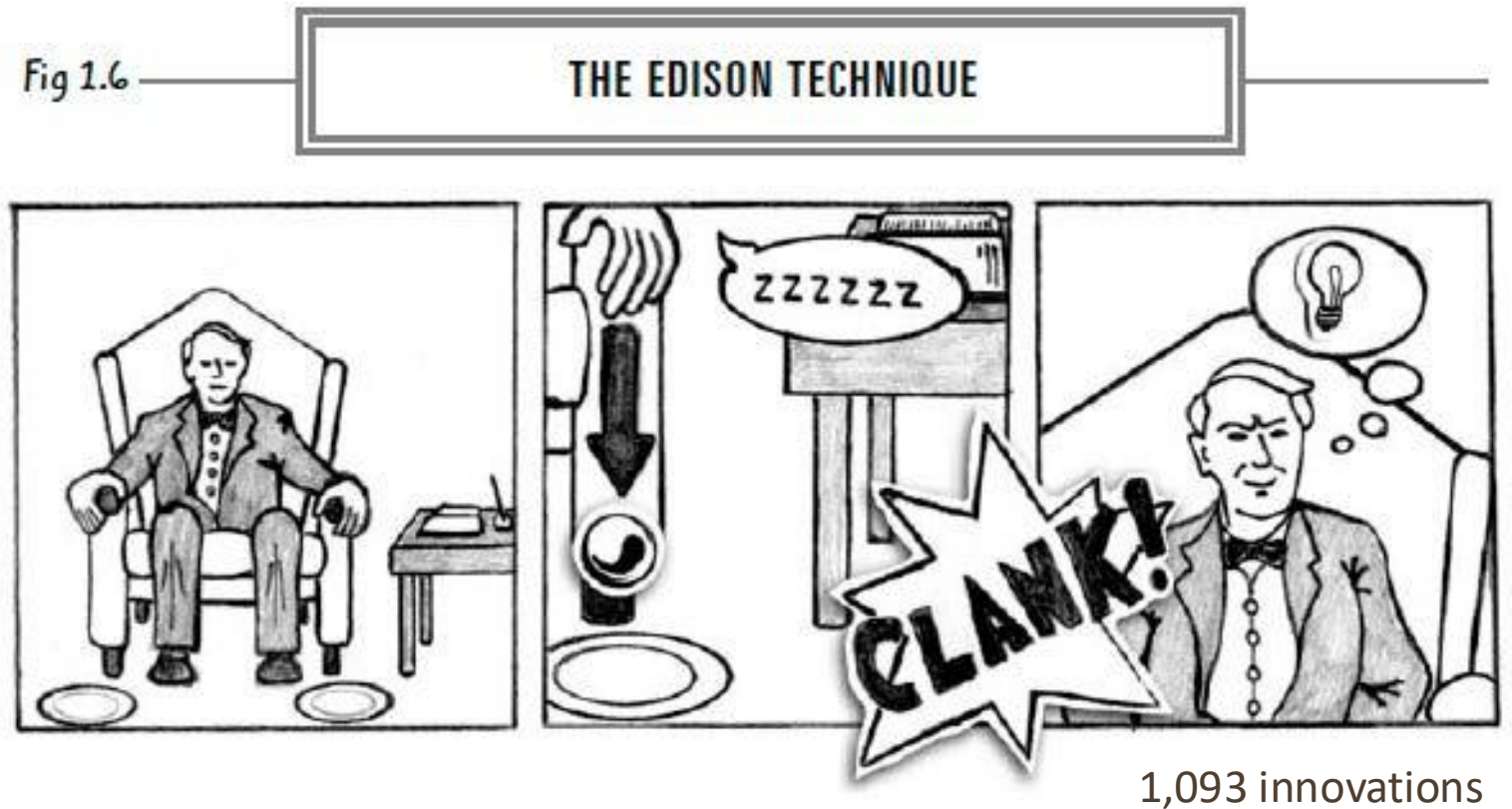
Similar: [comment on](#) [discuss](#) [evaluate](#) [assess](#) [appraise](#) [judge](#) ▼

# Research Question

- Address a question that hasn't been answered
- Must address something of significance
- Researchable ?

# Ideation and personas

- 'Aha' moment



<https://uxdesign.cc/why-do-creative-people-need-time-to-sit-around-and-do-nothing-307f3d8d7b16>





<http://www.greendealsolutions.net/wp-content/uploads/2013/03/strategies-for-change.jpg> [Accessed: 10 July 2014]

The British Dyslexia Association states, "Dyslexics struggle with their spoken and/or written language, following instructions, poor concentration and carrying out analytical or logical tasks. Strategies such as mind mapping are recognized as valuable learning tools."

The British Dyslexia Association, [www.bdadyslexia.org.uk](http://www.bdadyslexia.org.uk).

# Motivation

- Justification
  - Impact
  - Value of outcomes
  - Validity of outcomes
  - Implementation
  - Economic feasibility
- 
- Upliftment of Quality of Life
  - Serving the humanity

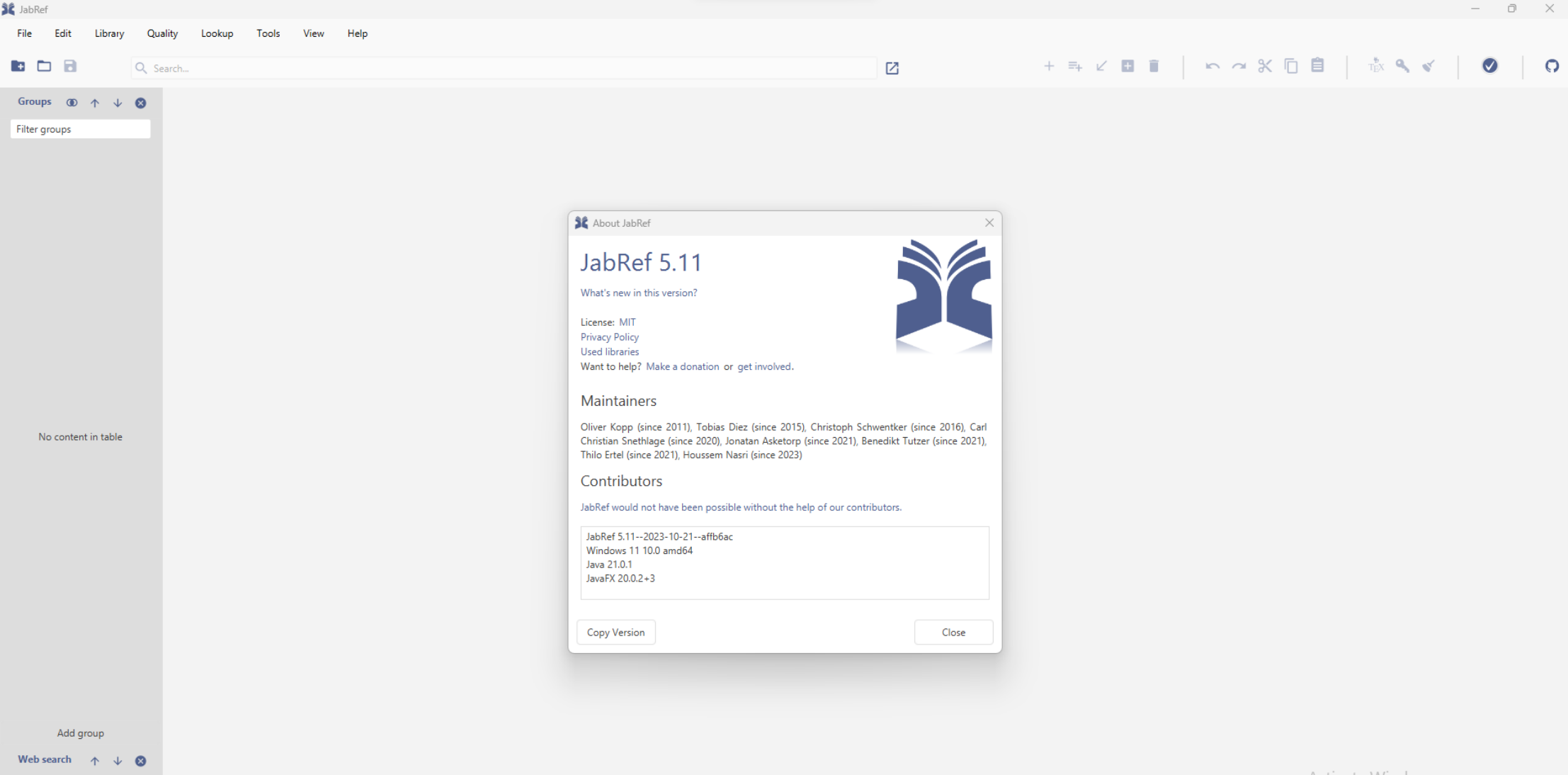


# Writing and Keeping Notes

- Do never wait for the last moment
- **Write** while you work – may be even daily basis
  - Adding gradually to the main argument
  - Remove the not relevant
  - So, ideas evolve in writing
  - Also building up the strength and quality.
- Always keep references with relevant facts
- Paraphrasing
- Plagiarism
- Online tools

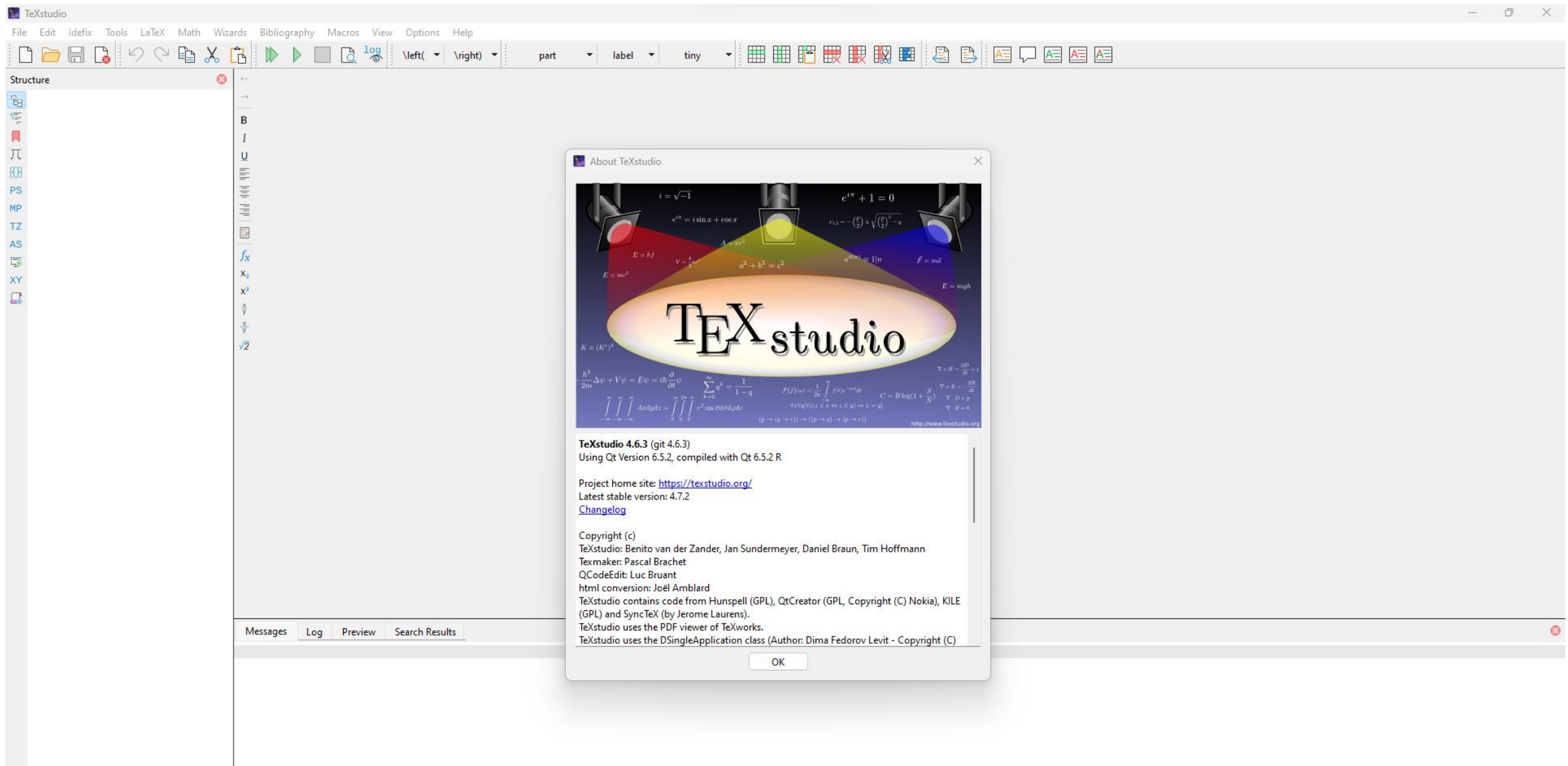


# Referencing Tools





# Typesetting Tools





# Online Tools

ieeexplore.ieee.org/Xplore/home.jsp

Basis Set Exchange...Rangsiman Ketkae...Rangsiman KetkaewClean Energy Demo...CO2SIM (Flowsheet...

IEEE.org | IEEE Xplore | IEEE SA | IEEE Spectrum | More Sites

Donate | Cart | Create Account | Personal Sign In

IEEE Xplore® Browse ▾ My Settings ▾ Help ▾

Access provided by:  
KDU - Gen. Sir John  
Kotelawala Defence  
University

Sign Out

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As the world's largest organization of technical professionals, IEEE is uniquely positioned to help organize the world's engineers, scientists, and technical professionals in addressing the causes, mitigating impacts, and adapting to climate change.

Go to the Collection





# Online Tools

The screenshot displays the ResearchGate website interface. At the top, there is a navigation bar with the ResearchGate logo, links for Home, Questions, and Jobs, a search bar, and user notification icons. The main content area is divided into three columns. The left column features a news feed with two entries: one by Mohamed A. Mohamed about a faulty feeder selection, and another by Hads Gimhana about a novel GPU-accelerated speed violation detection system. The middle column contains a 'Research Spotlight' section encouraging users to showcase their work. The right column lists job opportunities, including positions at Nanyang Technological University and The Chinese University of Hong Kong.

ResearchGate Home Questions Jobs Search for research, journals, people, etc. Add new

**News Feed:**

- Mohamed A. Mohamed** was cited in a publication  
**Faulty feeder selection based on improved Hough transform in resonant grounded distribution networks**  
Article February 2024 · 4 Reads  
International Journal of Electrical Power & Energy Systems  
Xiaowei Wang · Xinyu Qu · Liang Guo · [...] · Peng Wang  
Request full-text Save Follow Recommend Share
- Hads Gimhana** added a preprint  
**Novel and Real-Time GPU Accelerated Speed Violation Detection and License Plate Identification System**  
Preprint October 2021 · 145 Reads  
Udaya Dampage · KKN Hasanthan · Hads Gimhana · [...] · SV Maddumage  
Download Save Share

**Research Spotlight Beta**

Want 4x more reads of your recent work?

Showcase your work in a Spotlight to get **4x more reads** on average. [Learn more](#)

Create Spotlight

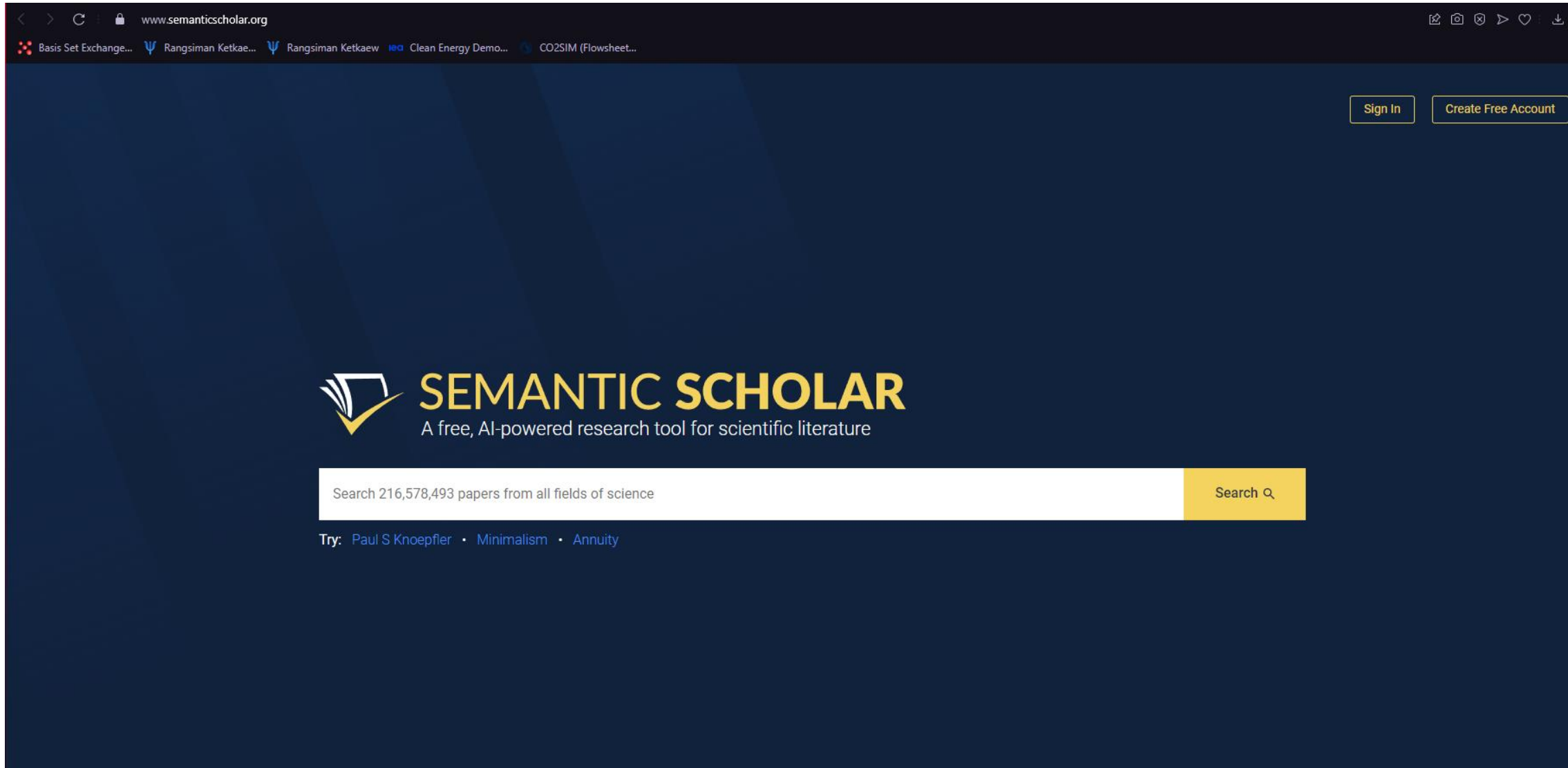
**Jobs you may be interested in**

- Nanyang Assistant Professorship (NAP)**  
Expires in 5 days  
Nanyang Technological University
- Assistant Professor(s) / Associate Professor(s) (Sustainability Governance)**  
Expires in 3 days  
The Chinese University of Hong Kong
- 西安电子科技大学杭州研究院诚聘英才**  
Xidian University  
Hangzhou, China

160+ million publication pages, 25+ million researchers




# Online Tools



The screenshot shows the homepage of Semantic Scholar, a free, AI-powered research tool for scientific literature. The browser address bar displays [www.semanticscholar.org](http://www.semanticscholar.org). The page features a dark blue background with a large, stylized 'S' logo. The text 'SEMANTIC SCHOLAR' is prominently displayed in yellow, with the tagline 'A free, AI-powered research tool for scientific literature' below it. A search bar is located in the center, containing the text 'Search 216,578,493 papers from all fields of science'. To the right of the search bar is a yellow button labeled 'Search' with a magnifying glass icon. In the top right corner, there are two buttons: 'Sign In' and 'Create Free Account'. The bottom of the page shows a footer with the text 'Try: Paul S Knoepfler • Minimalism • Annuity'.

www.semanticscholar.org

Sign In Create Free Account

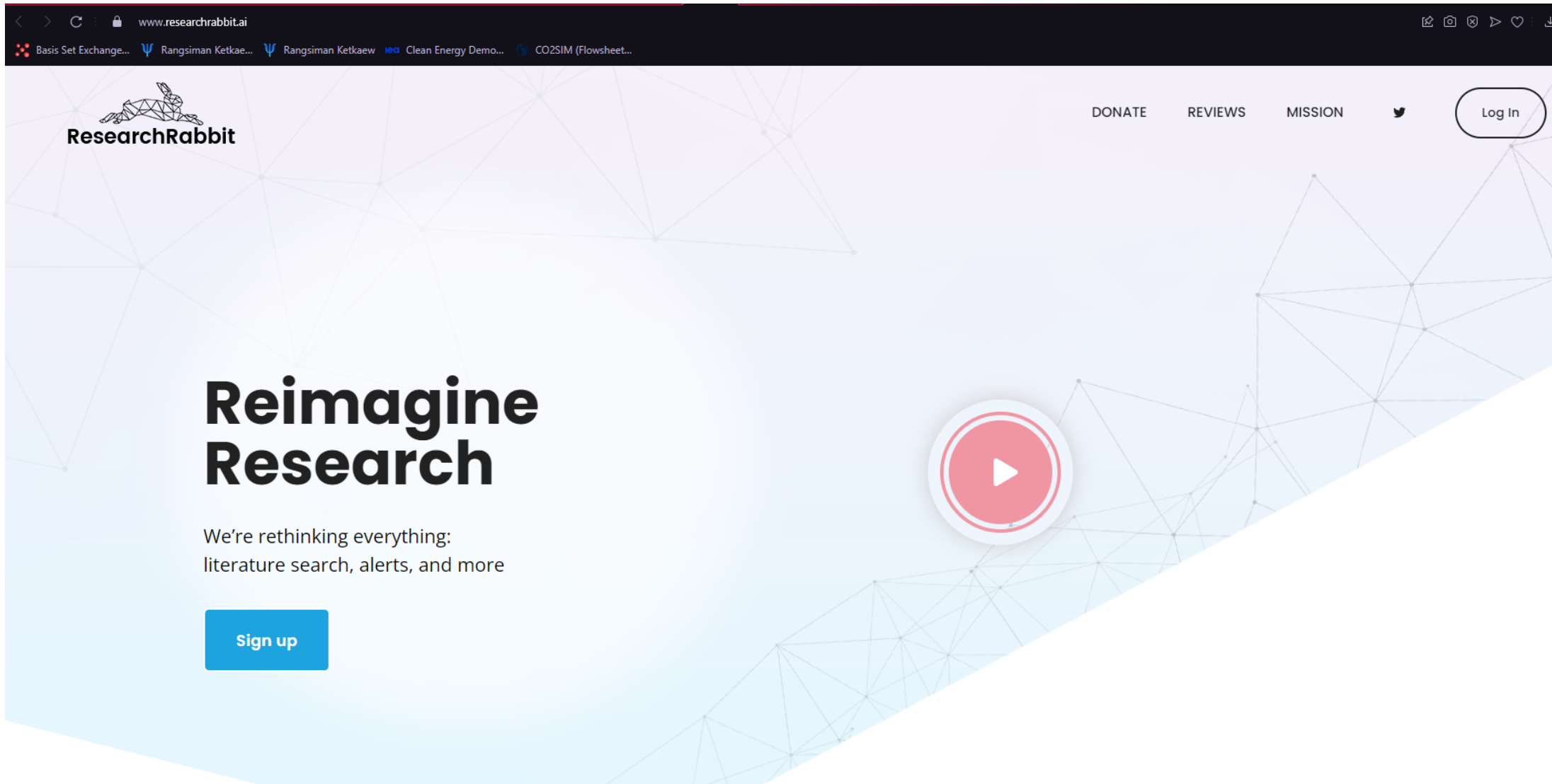
 **SEMANTIC SCHOLAR**  
A free, AI-powered research tool for scientific literature

Search 216,578,493 papers from all fields of science Search

Try: [Paul S Knoepfler](#) • [Minimalism](#) • [Annuity](#)




# Online Tools




# Online Tools


inciteful.xyz

Basis Set Exchange...Rangsiman Ketkae...Rangsiman KetkaewClean Energy Demo...CO2SIM (Flowsheet...

Inciteful

Help


 Follow



# Tools to help you accelerate your research

Build a network of academic papers and we'll analyze the network to help you **discover** the most relevant literature.

Search for the title of a paper to get started.




or [Import BibTeX file](#)

Select two papers and we will show you how the **literature connects** them together.

From:

To:



## Find the most relevant literature, faster

The goal of Inciteful is to give the world free tools to help accelerate academic research. If that means getting up to speed on a new topic, finding the latest literature, or figuring out how two ideas are connected, we can help. Unlike a traditional search engine, citations are the cornerstone of all of our tools. Building these tools for all academic literature has only recently been possible with the rise of open scholarly bibliographic data and the amazing work being done by the these groups.

To date we have two tools. Paper Discovery and the Literature Connector. More tools are actively under development.

The Paper Discovery tool builds a network of papers from citations, uses network analysis algorithms to analyze the network, and gives you the information you need to quickly get up to speed on that topic. You can find the most similar papers,

Our second tool was the Literature Connector. Intended for interdisciplinary scholars trying to bridge two domains, it allows you to enter two papers and it will give you an interactive visualization showing you how they are connected by the literature. From there you can send the papers you find into our Paper Discovery tool to find other relevant literature which happened to not be the "shortest path" between the two papers.

Inciteful is under active development and our hope is that, over time, our tools will build upon each other giving you an unrivaled experience for quickly discovering new literature.

Being built off the backs of free and open data, we commit to paying it forward by keeping our own tools free for everyone. To learn more, head over to our about page.

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# Online Tools

typeset.io

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Literature Review

Extract data from PDFs

Read with AI Copilot

Paraphraser

Get insights from top papers directly

TRY NEW AI SEARCH

Try asking or searching for:

How does climate change impact biodiversity?

Why are aging Covid patients more susceptible to severe complications?

How does social media affect the college selection process?

What are the interesting theories about dark matter and dark energy?

What is the significance of higher-dimensional algebra?

SciSpace is an incredible (AI-powered) tool to help you understand research papers better. It can explain and elaborate most academic texts in simple words.

Mushtaq Bilal, PhD | Researcher @ Syddansk Universitet

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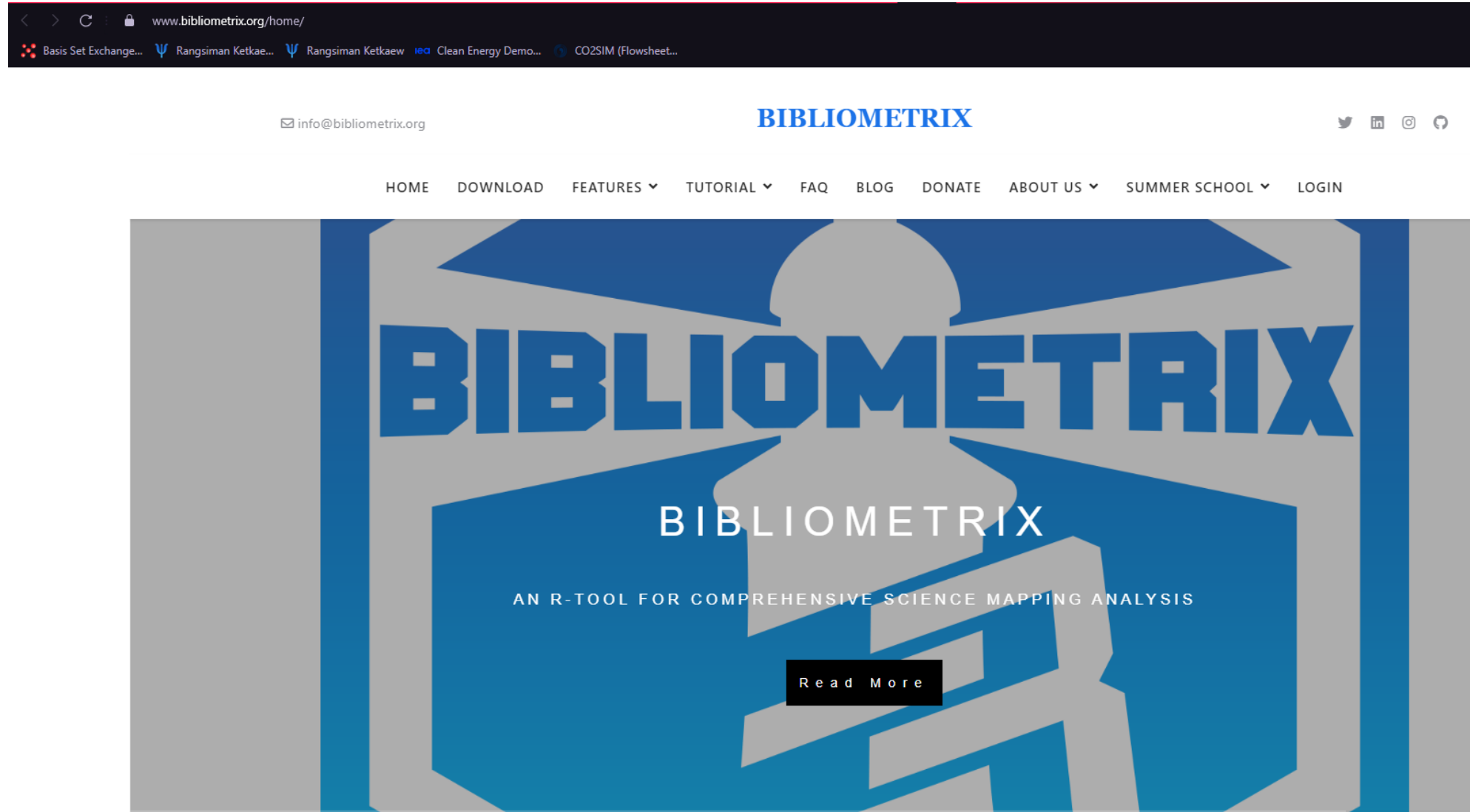
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# Online Tools



# Online Tools

The screenshot shows the Microsoft Power BI website. At the top, the browser address bar displays `www.microsoft.com/en-us/power-platform/products/power-bi`. The navigation bar includes the Microsoft logo, "Power Platform", and links for "Power BI", "About Power Platform", "Products", "Pricing", and "Resources". On the right, there are buttons for "Buy now", "Start free", and "Sign in". A light blue banner below the navigation bar promotes the "Microsoft Fabric Community Conference" with the code "MSCUST". The main content area features the "Power BI" title and the tagline "Uncover powerful insights and turn them into impact". A central box contains a bar chart icon, the text "Connect to and visualize any data, and seamlessly infuse visuals into the apps you use every day.", and two buttons: "Get Started" and "Have an account? Sign in". The background of this section has a large, abstract orange and yellow wave graphic. At the bottom, a navigation bar lists "Product overview", "Use cases", "Research and news", "Pricing", "Interoperability", "Security", "Customer stories", and "Resources". The "Product overview" link is underlined. To the right of this bar are "Sign in" and "Get started" buttons. The footer of the page is a solid light green color.

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Join us for the [Microsoft Fabric Community Conference](#), the ultimate learning event for Fabric, Power BI, SQL, AI, and more. Use code MSCUST for an exclusive discount.

## Power BI

Uncover powerful insights and turn them into impact

 Connect to and visualize any data, and seamlessly infuse visuals into the apps you use every day.

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# Online Tools

www.mindmaps.com/what-is-mind-mapping/

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**mindmaps.com**  
THE ULTIMATE GUIDE TO MIND MAPPING

HOME MIND MAP BASICS USE CASES BY INDUSTRY

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- What is Mind Mapping
- How to Make a Map
- Software Comparison

**USE CASES**

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- Brainstorming
- Project Planning

**BY INDUSTRY**

- Business Management
- Education
- Marketing

https://www.mindmaps.com

## Understand What is Mind Mapping and Its Many Uses

### What is Mind Mapping? What Are Its Uses?

Mind mapping is a powerful technique to help you visually develop and organize ideas and information. Let's take a look at what mind mapping is and how you can use it.

```
graph LR;
    A[Central Topic] --- B[Supporting Idea];
    A --- C[Supporting Idea];
    A --- D[Supporting Idea];
    A --- E[Supporting Idea];
    A --- F[Supporting Idea];
```

Mind Mapping is a powerful note-taking method, great when you need to think creatively. To use effectively, use different colors.



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"I have not failed. I have just found 10,000 ways that won't work"

Thomas Edison

Thank You..

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