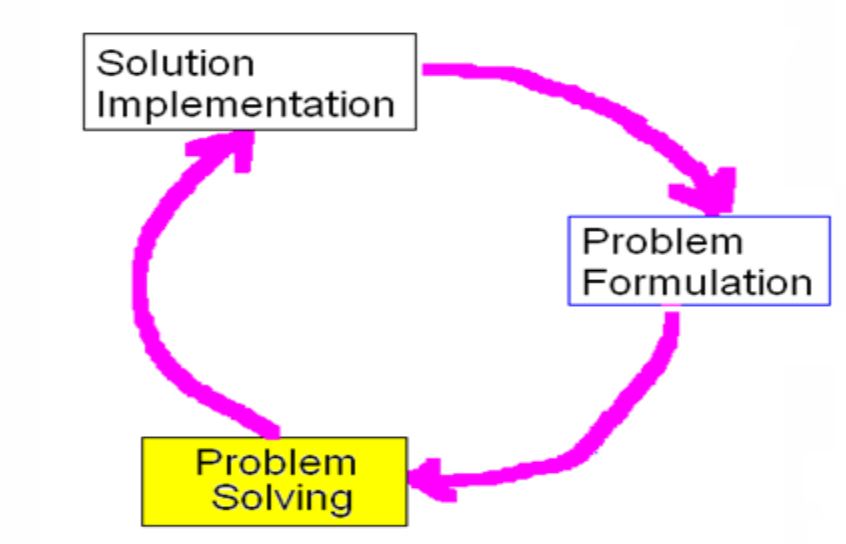
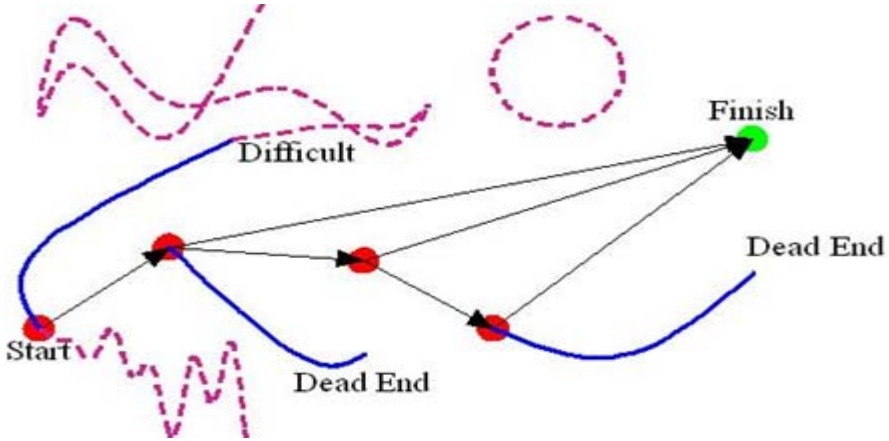
# Solution Generation




www.mwftr.com/SD1718.html

# Problem Solving → Solution Generation

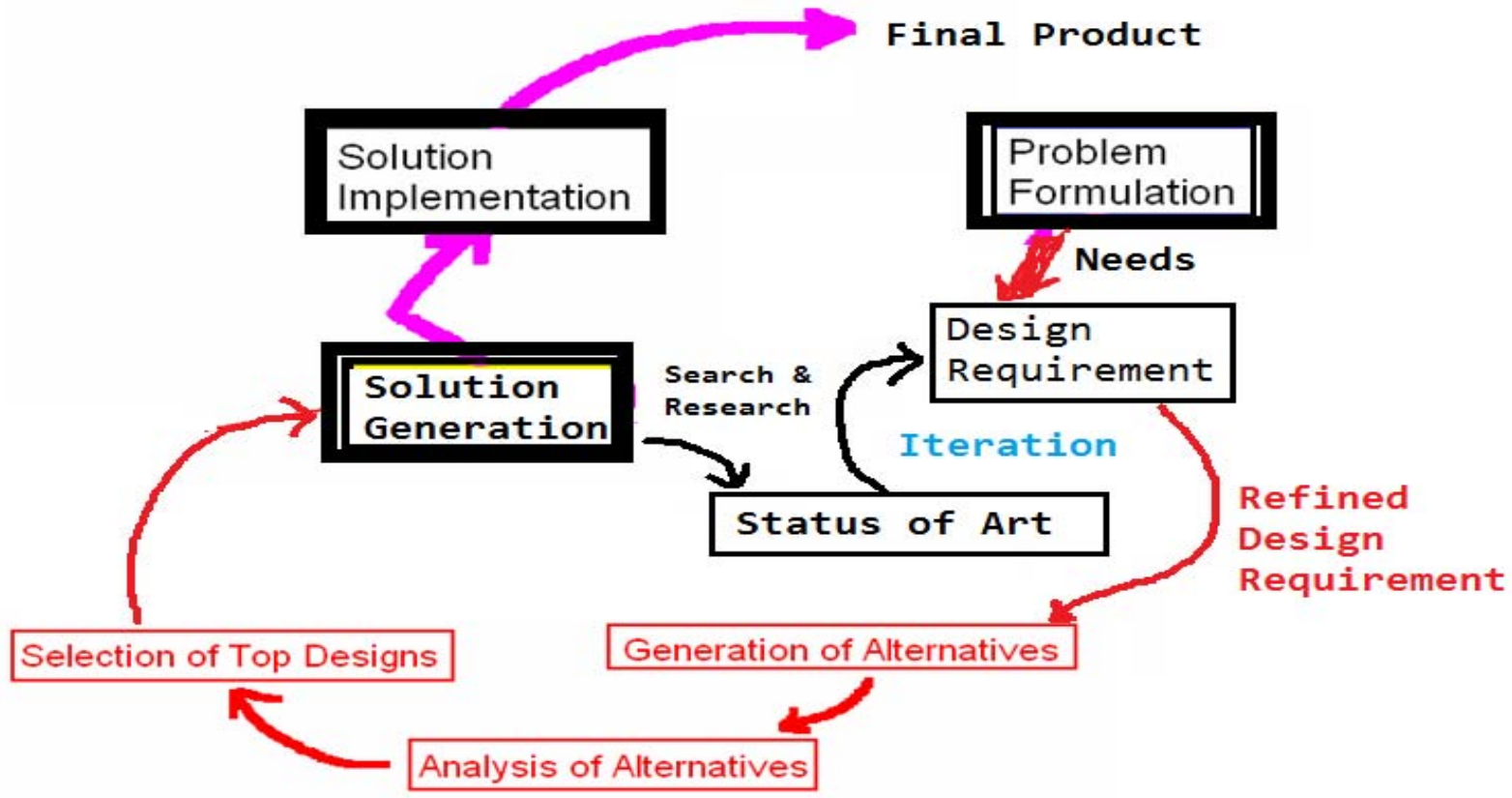



- Objectives:
  - –Current Status of Art
  - –The steps of problem solving
  - –Conceptual Design Approach for Solution Description
  - –Strategies for generating, analyzing, and selecting alternatives

# Next Step After Design Requirement

- Problem Statement (Need) was defined
- Design Requirements --- Technical Interpretation of needs – were quantified
- Next Step: **Solution Generation** to meet the need
- Solution Generation Steps
  - 1. Understanding the **C**urrent **S**tatus of **A**rt (CSA)– "how others have done or are doing to solve the problem or meet the need"
  - 2. Refinement of Design Requirement based on the CSA
  - 3. Initial Solution Generation → Conceptual Design
  - 4. Generation of Alternative Designs/Solutions
  - 5. Selection of the Top Solution

# Steps for Solution Generation

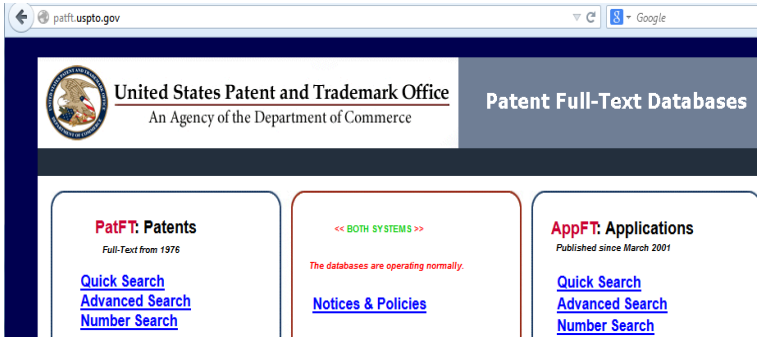


# 1 Current Status of Art

- Study and understanding of the field knowledge around the needs and problems – core principle of technology and theory, etc ← **Basic Theory Focus**
- The current status of the field related to the needs and problems -- products, patents, research and development, etc ← **Product Focus**
- Main Focus:
  - Is the “problem” already solved?
  - What are the currently available, similar products ?
  - Is there any room for improvement or addition?

# How to know/investigate the current status of art

- **Three primary activities**
  - 1 Working with customers/Advisors/Assistant to get information on Basic Theory/Principle of the Field
  - 2 Research/Study for Information
    - **Patent Search ---** Google Patent Site, USPTO patent search site, and General Web search
    - **Online search**
      - Technical articles on product/technology introduction
      - Be careful:
        - » Accuracy and Authority
        - » Objectivity
        - » Currency
      - Existing products
  - 3 Discussion within the team



## What is the eventual goal for “the current status of art” Investigation

- Focus:
  - Is the problem already solved?
  - Are the customer needs can be met by a product or a combination of multiple existing products?
  - Difference between the existing technology/product and the problem/needs?
  - Any room for improvement? How to improve?
  - How to define the new product to be developed considering overall current status of art in the field?
  - If there is no invention nor technology (principle or theory) nor product in the market, how to proceed to develop the technology?

# Team Assignment: Report on Current Status of Art

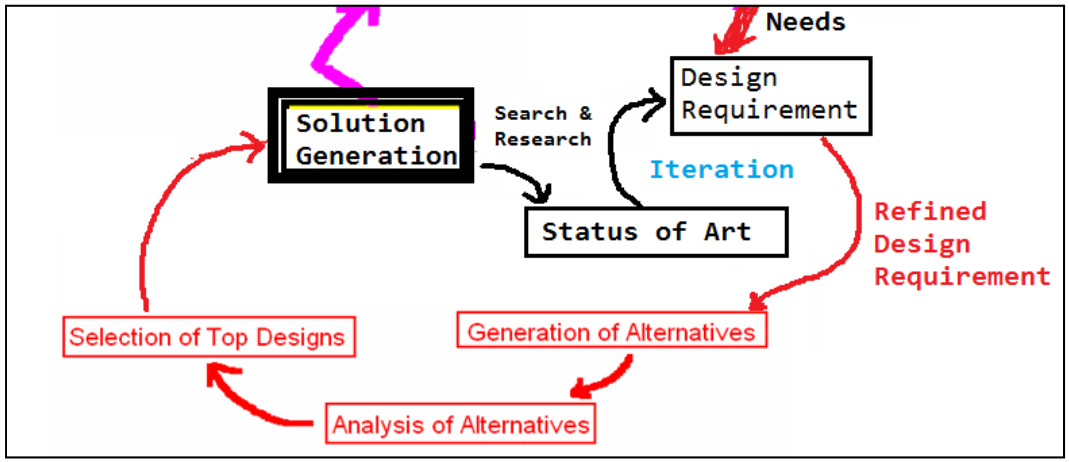
- The current status of the **product** and **the technology** related to your team project
- A. Should answer the following questions:
  - 1. What is the core principle or theory of the technology involved in the project? (← Basic Theory Focus)
  - 2. What kind of products (for the same desired functions) are out there in the market, if there are any? (← Product Focus)
  - 3. Fundamental Questions to be Answered
    - What's the relevant technology (principle or theory)
    - What are their advantages and disadvantages against the needs?
    - What  and how would improve the products and meet the needs?
    - How would the Status refine/revise/change the design requirement

# Team CSA Report --- Detailed Instruction

- B. Report (**hardcopy only**) **Email submission not accepted**
  - Concise, technical, professional, with your own words
  - Letter size, 1" margin all sides, 12 pt. Times New Roman font. Single space. Left justified. 3 – 4 pages.
  - No cover page;
    - line 1 (Project title);
    - line 2-3; member names and IDs; l
    - line 4; Date;
    - line 5: space;
    - line 6: First line of your first paragraph (which should summarize the entire report).
    - Then, the rest of the report body follows.
      - Divide into 2 sections:
        - » Section 1: Status of Relevant Technology (Principle or Theory)
        - » Section 2: Status of the Relevant Products
        - » Section 3: How would the Status refine/change the Design Requirement
  - Submission Due: October 18, 2017

# Solution Generation Steps

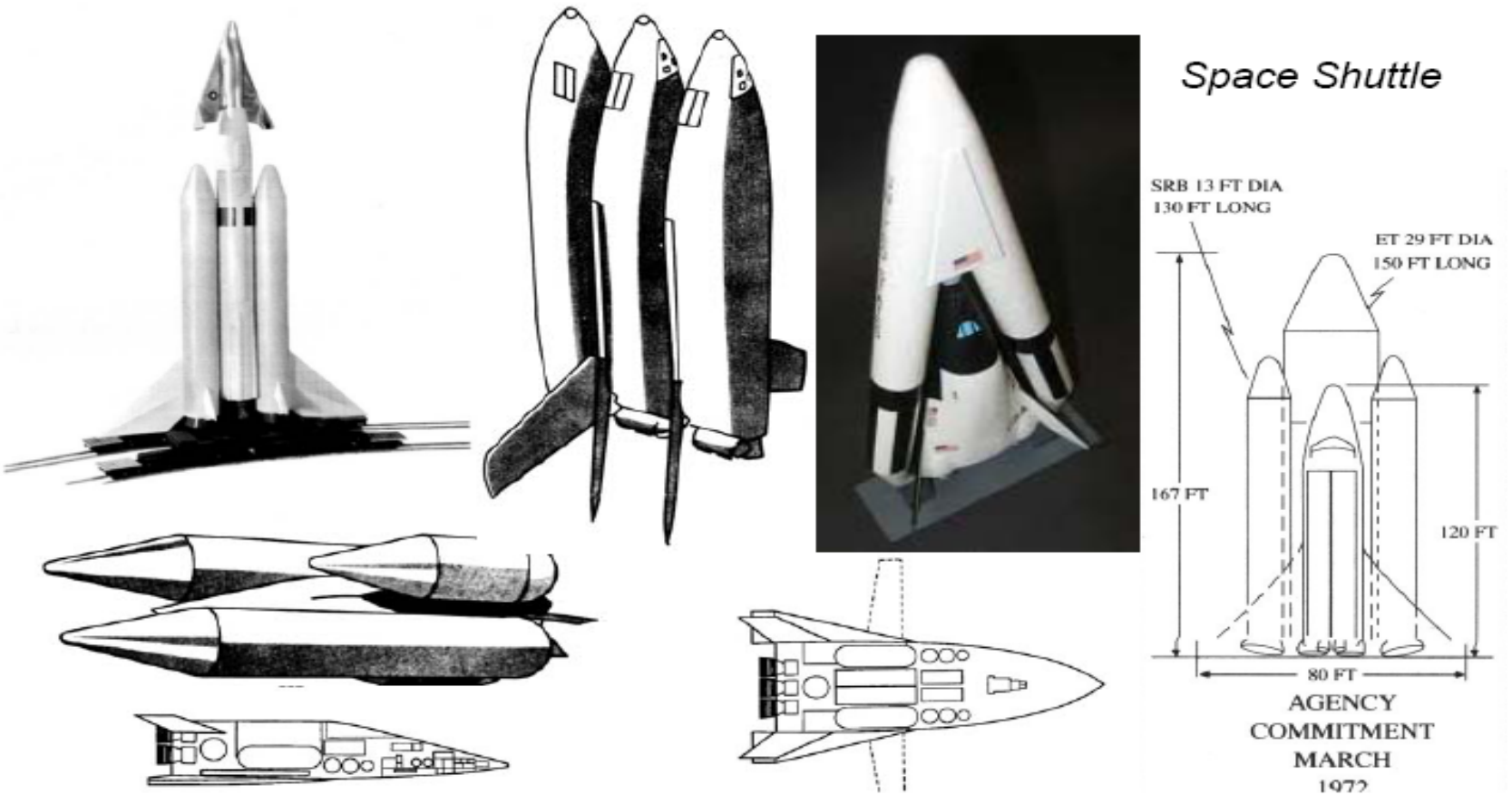
- After CSA is done, what's the next step?
  - Start with the New Refined Design Requirement
  - Initial solution generation → Conceptual Design
  - Expansion of the solution space and generate alternative solution designs
  - Analysis of the ALL the solution design
  - Select the top solution design



# Generation of solutions (and Alternatives)

- The act of expansion - all possible solutions
- Overcome the temptation to adopt the first idea
- Building on the initial conceptual design and add alternative ways of achieving the solution
- Wide design space but true to the problem (and functional requirements) → better approach, better efficiency, economical way, etc.

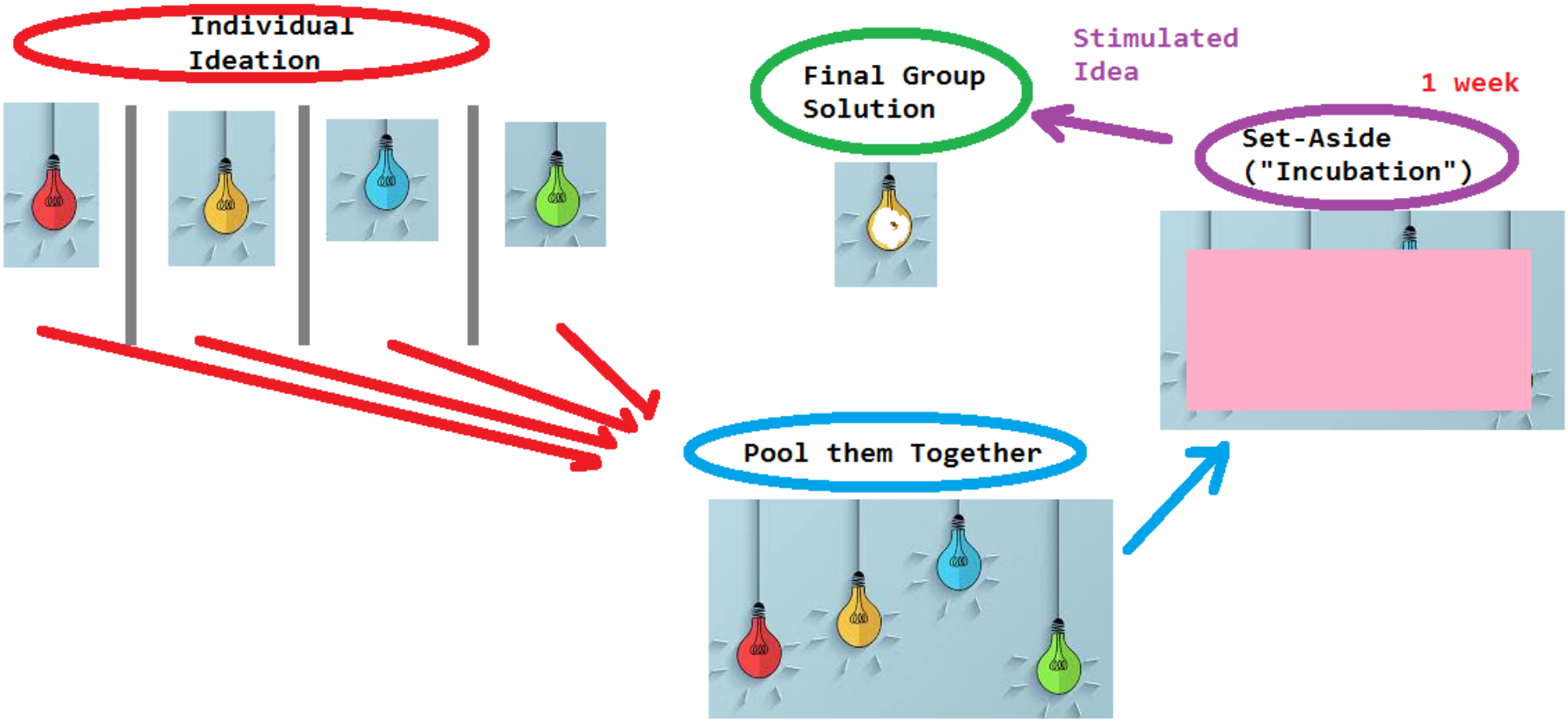
# Remember the different designs of space shuttle?



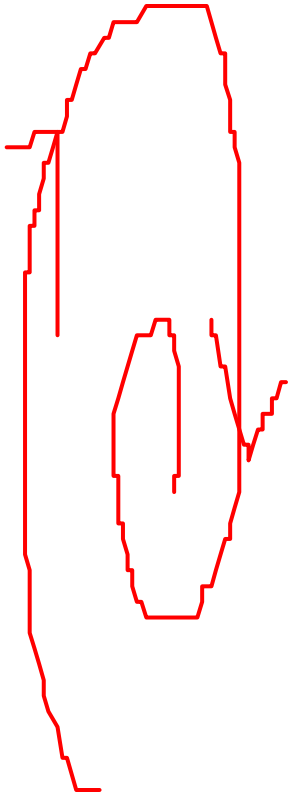
# How do I/We generate solutions?

- **Period of Ideation** is a vulnerable period of ideas
- Use **creativity** – remember that you're more creative than your daily life shows
- More ideas can be generated if team members first develop ideas individually and then pool them together
- Setting the problem aside and then returning to it ("**incubation**") helps stimulate more idea generation

# How do I/We generate solutions?



# Team Idea Generation Strategy



1. Individually, think of the problem and generate ideas – Individual Idea Generation
2. In the team meeting (Week 1), present individually generated ideas - Pool
3. Set the problem aside (Week 2) - Incubation
4. Work and build on the pooled ideas (Week 3) – Final Group Solution
5. If no satisfactory solution is achieved, go to Step 1 and do the steps again.

# How do I/We generate solutions?

What is TRIZ?

(a)Tree Root Induced Zinc

(b)Thick Rough Interior Ziggurat

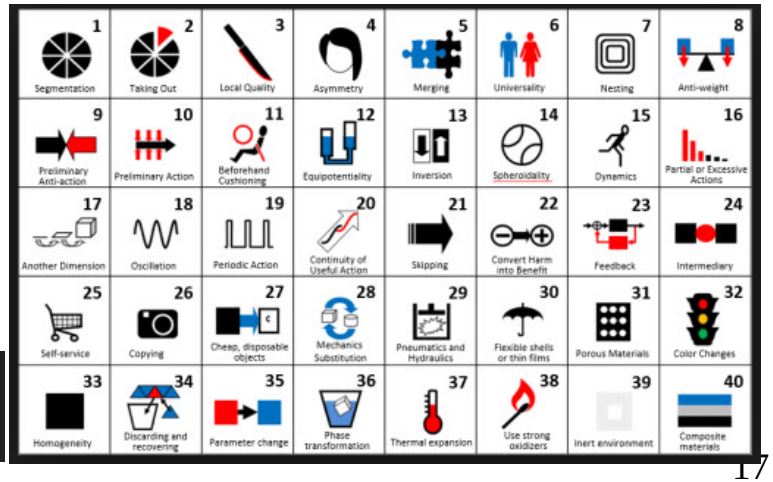
(c)Teoriya Resheniya Izobreatatelshkihk Zadatch

(d)None of the above

# Problem Solving with TRIZ

- Problems with Brainstorm Approach
  - Intuition
  - Random and trail-and-error
  - Initial tendency and Inertia Vector
- Is there “Technology of creativity”?
- TRIZ ( *Teoriya Resheniya Izobreatatelskikh Zadatch* ) ТРИЗ
  - Theory of Inventive Problem solving
  - Algorithmic approach
  - By Genrich Altshuller

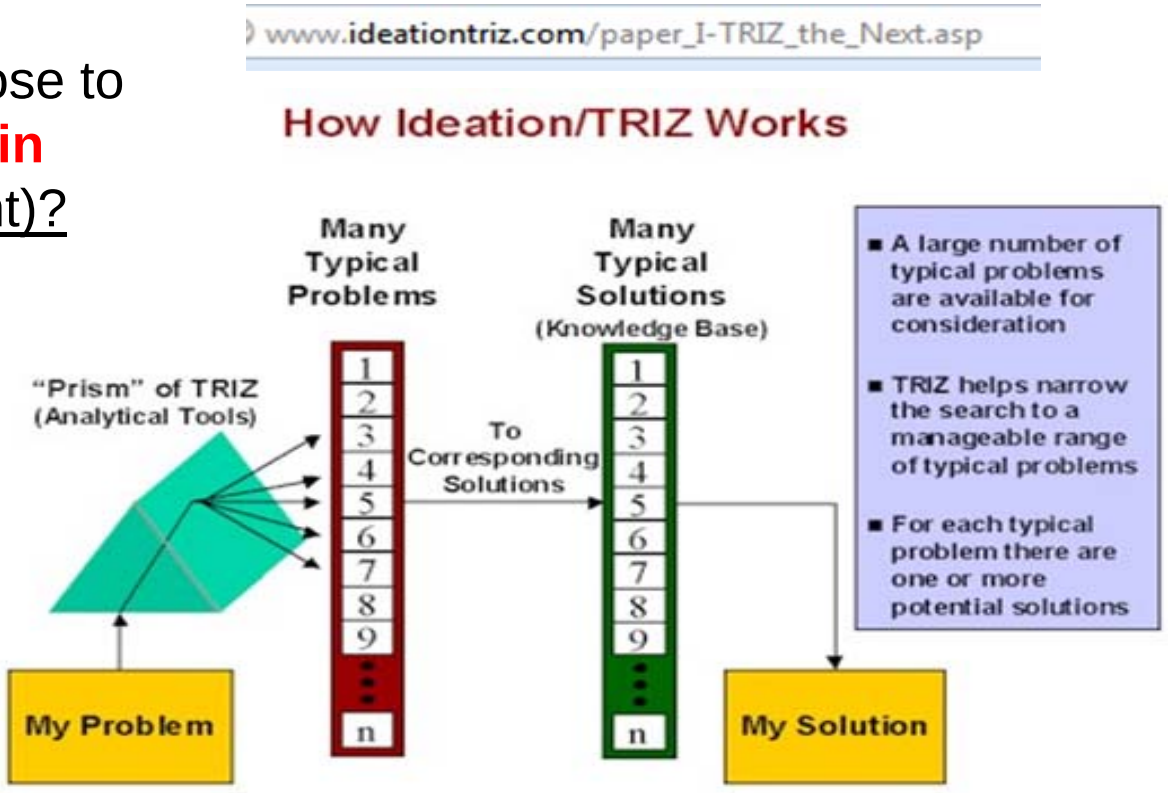
List of Triz Inventive Principles
Quality Assurance Solutions - 500 × 304 - Search by image



# How do I/We generate solutions?

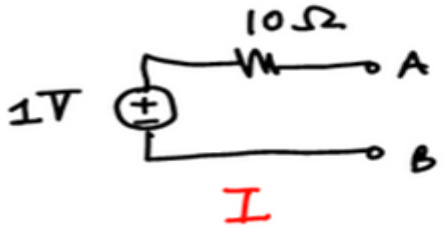
- **Ask**, using the TRIZ approach:
  - How are problems close to the given one solved **in other fields** (of patent)?
  - How are **similar problems** solved in leading industries?
  - How are **opposite problems** solved?

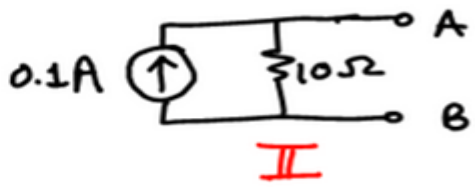
- Generate **multiple alternative** ideas



# Exercise #1

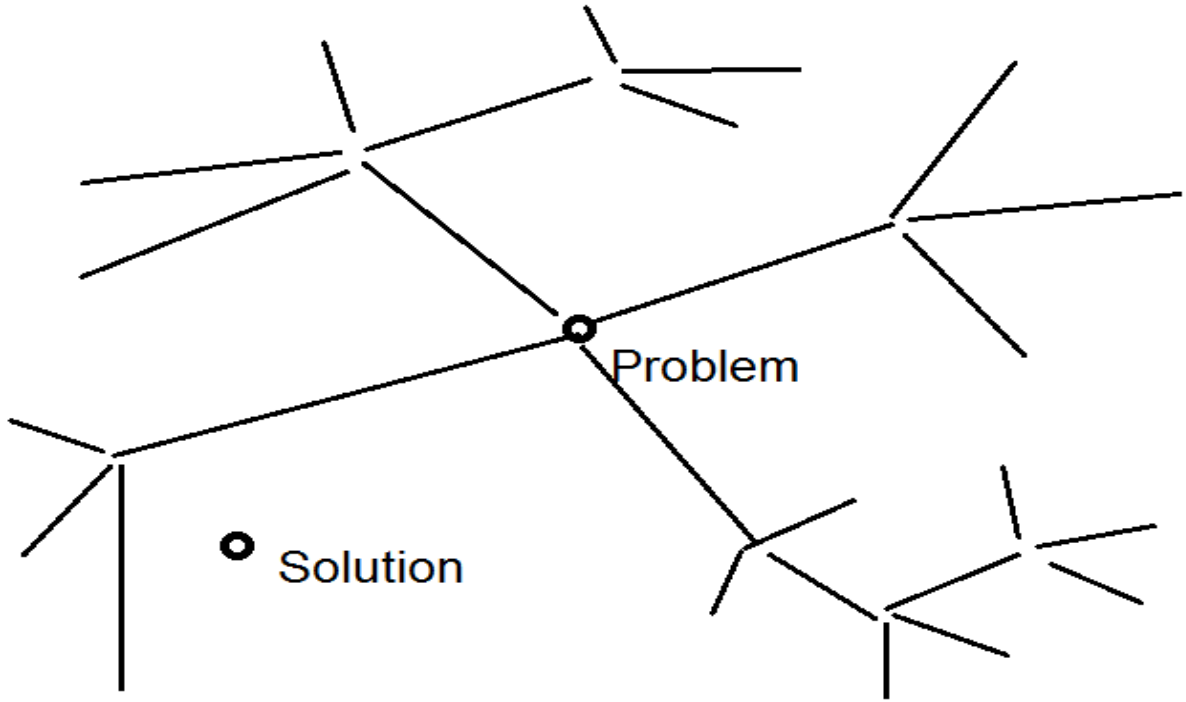
- **Two circuits I and II shown below are equivalent, one being a Thevenin circuit and the other a Norton. A technician built a circuit with an actual power source and an actual resistor, and put the circuit inside a metal box, and made out two terminals A and B. How do we know if the circuit made inside the metal box is of circuit I or II? Write your solution approach and solution and submit. In writing, be conscious of your thinking process .**




# Thinking Process of Exercise #1

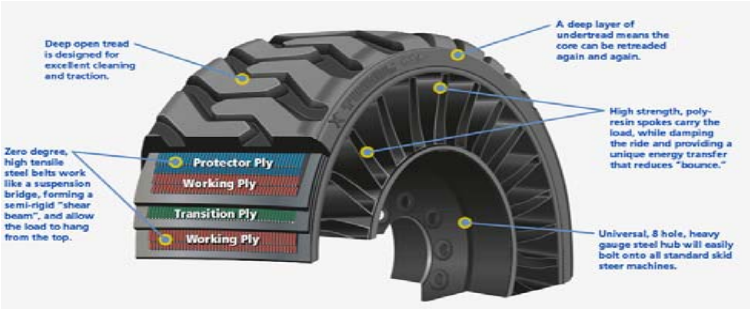
- Which circuit is inside the box?
- Thinking Process



# Conflicting Requirements

- 

# TRIZ and Tweel


# TRIZ and Tweel

Article

## Why Reinvent The Wheel? The Efficacy Of Systematic Problem Solving Method TRIZ And Its Value For Innovation In Engineering And Its Implications For Engineering Management

trizjournal | On 12, Aug 2006

**By: Dr. Paul R. Filmore, Dr. Pete Thomond**
Dr. Paul R. Filmore
pfilmore@plymouth.ac.uk
Senior Lecturer
School of Computing, Communications & Electronics
University of Plymouth
UK

The Tweel™ development fits well conceptually into the 'breakthrough' or step change development category. On investigation it seems that the innovative breakthrough only happened after an 'unproductive' team (in terms of breakthrough innovation), undertook a course in systematic problem solving based on TRIZ. We thus have here a case study that is approachable (everyone can relate and comment on wheels!), is dramatic and has a human story.

The TRIZ tools that were introduced from this case study were specifically 'Ideal Final Result' and 'Trends of Evolution'. Other tools such as 'Function and Attribute Analysis' were introduced briefly to introduce the importance of the initial problem definition phase.

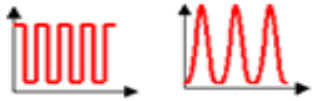
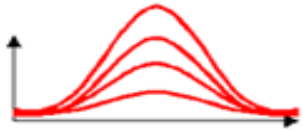
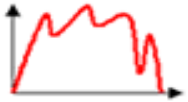
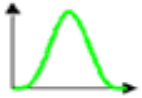
# TRIZ – 40 Principles

## Altshuller's 40 Principles

| | | |
|---|---|---|
| 1. Segmentation | 15. Dynamics | 28. Mechanics substitution |
| 2. Taking out | 16. Partial or excessive actions | 29. Pneumatics and hydraulics |
| 3. Local Quality | 17. Another dimension | 30. Flexible shells and thin films |
| 4. Asymmetry | 18. Mechanical vibration | 31. Porous materials |
| 5. Merging | 19. Periodic action | 32. Color changes |
| 6. Universality | 20. Continuity of useful action | 33. Homogeneity |
| 7. "Nested doll" | 21. Skipping | 34. Discarding and recovering |
| 8. Anti-weight | 22 "Blessing in disguise" | 35. Parameter changes |
| 9. Preliminary anti-action | 23. Feedback | 36. Phase transitions |
| 10. Preliminary action | 24. 'Intermediary' | 37. Thermal expansion |
| 11. Beforehand cushioning | 25. Self-service | 38. Strong oxidants |
| 12. Equipotentiality | 26. Copying | 39. Inert atmosphere |
| 13. The other way around | 27. Cheap short-living | 40. Composite material films |
| 14. Spheroidality | | |

List of Triz Inventive Principles
Quality Assurance Solutions - 500 × 304 - Search by image

# TRIZ – 40 Principles

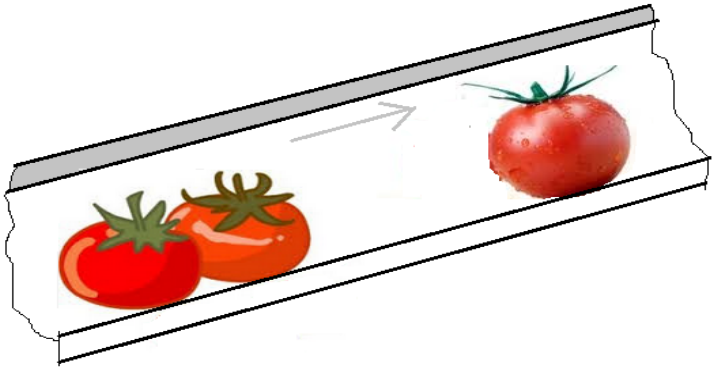
| | Space | Time | Interface |
|---|---|---|---|
| |  |  |  |
| Segment |  |  |  |
| Magnify |  |  |  |
| Re-shape |  |  |  |
| Modify |  |  |  |
| Substitute |  |  |  |

# TRIZ – IFR (Ideal Final Result)

- IFR
  - 1. Describes an ideal solution to a problem free of any mechanisms or constraints from the original problem or issue
  - 2. Start from defining the problem:
    - Make a benefit better OR
    - Reduce or eliminate a negative effect
  - 3. Find the gaps between where you are and IFR
  - 4. Identify the root cause issues that are causing the gap

# Exercise #2

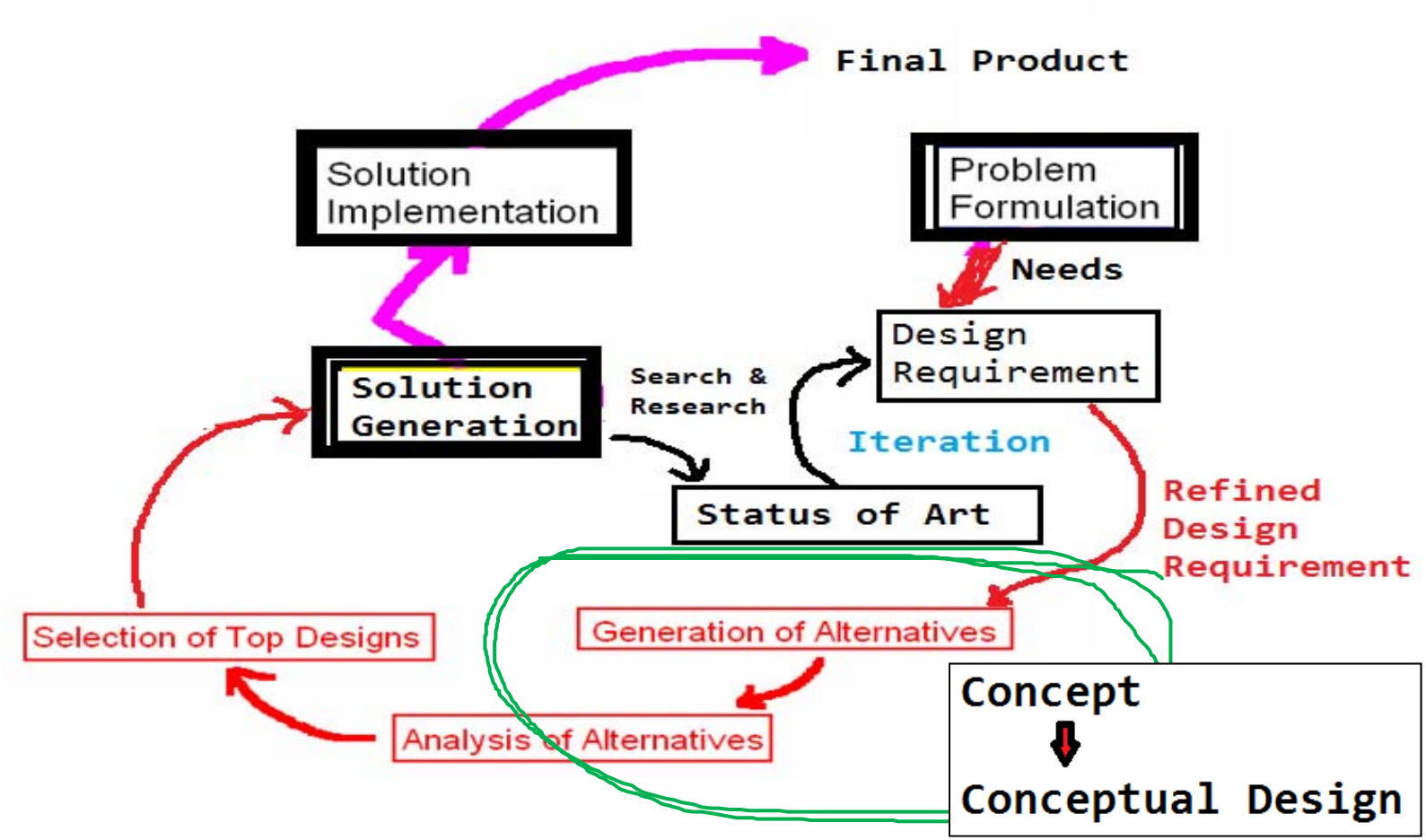
- There is a pneumatic conveyer made in the form of an inclined pipe. Small products (such as tomatoes) move from the lower to upper ends of the pipe under air pressure from the bottom of the pipe. The shortcoming of the system lies in the tomatoes rubbing and hitting against each other, and finally getting spoiled.
- A pneumatic transportation system is required that moved tomatoes with an absolute guarantee of a safe distance between them. It is undesirable to remove the pneumatic transportation system because this might require new equipment that is not available.



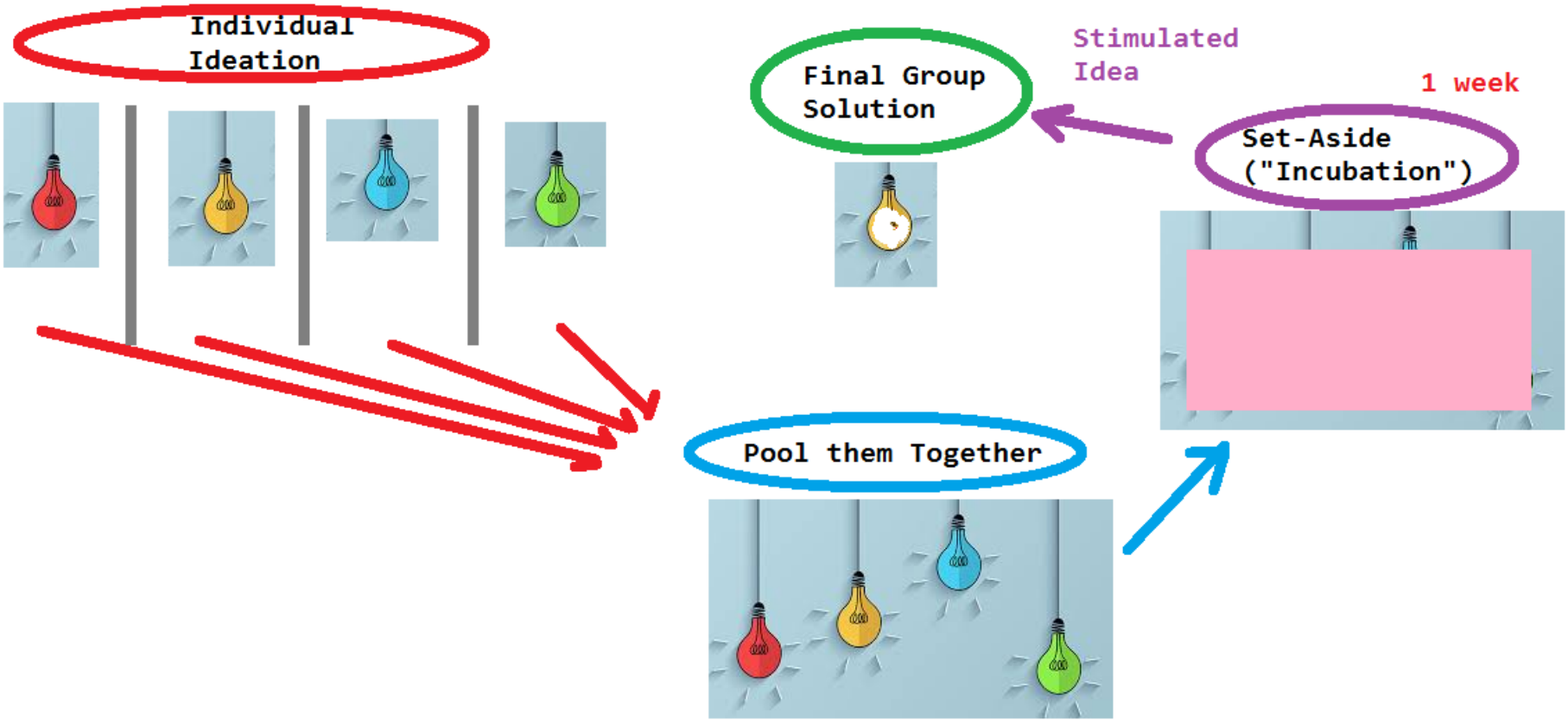
**Solve the problem by starting with IFR (Ideal Final Result)**

Credit: The Innovation Algorithm by Genrich Altshuller

# Generation of multiple solution approaches

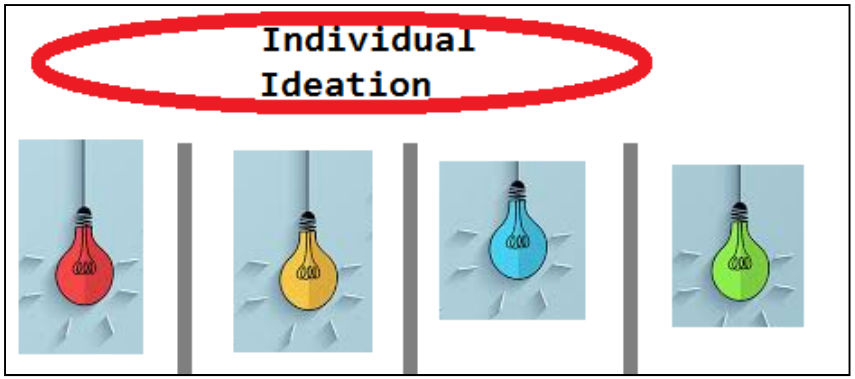


# Recall: Solution Generation Approach



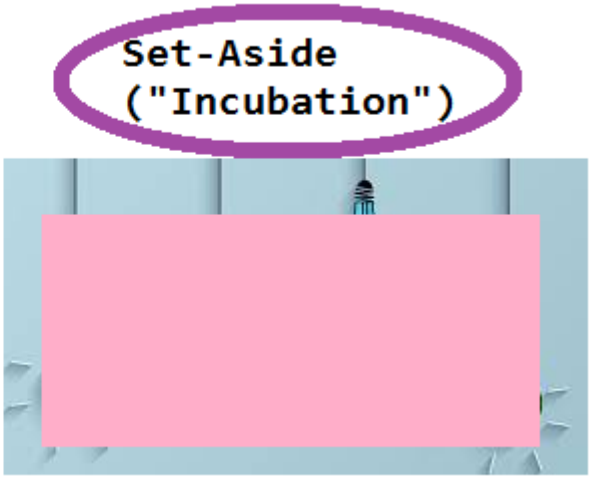
# Team Activity -- **"Team Conceptual Design Generation"**

- **STEP 1: Give assignment to each team member to bring up Individual Solution Concept/Idea** – each team member works separately without discussion
  - Individual Solution Concepts and Ideas
  - Remember: The solution should satisfy the design requirements
  - Bring the individual solution concepts and ideas to the next team meeting



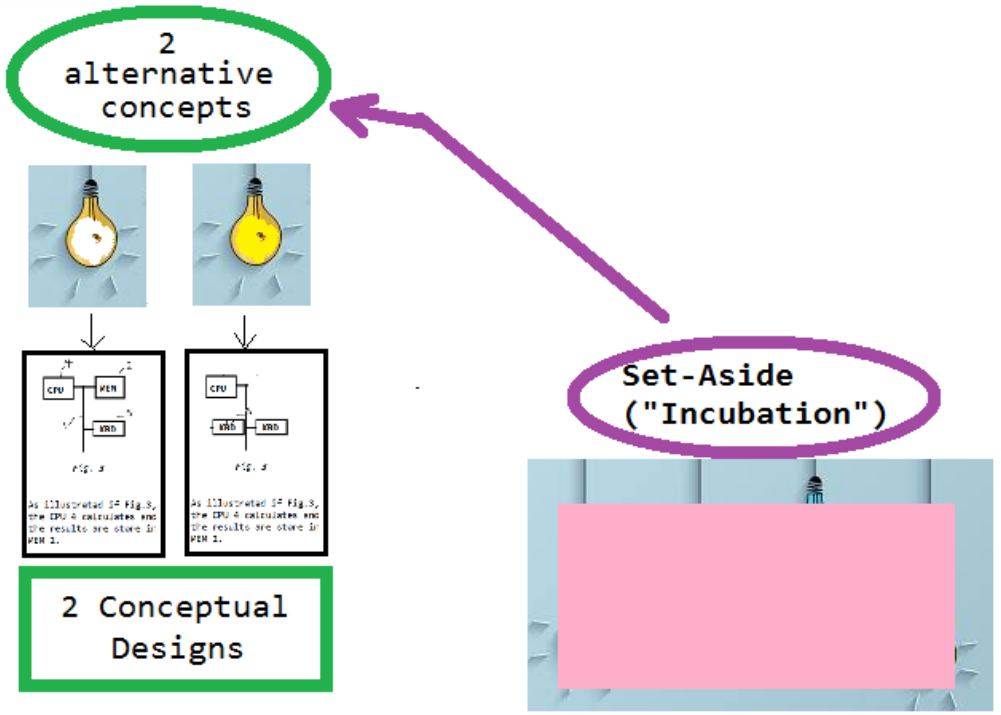
## Team Activity -- **"Team Conceptual Design Generation"**

- **Step 2:** Hold a team meeting to produce <u>at least two (2) team solution concepts</u>
  - Discuss on the individual concepts/ideas
  - Incubation Period ( no more than 1 week)

# Team Activity -- **"Team Conceptual Design Generation"**

- **Step3:** Generation of Team Solution Concepts
  - Develop into at least 2 team solution concepts
  - **Describe with figures** to produce two (2) team **conceptual designs**.



## Team Activity -- **"Team Conceptual Design Generation"**

- **Step 4: Submission**
  - Submit all **individual Concepts/Ideas** (from all team members)
  - Submit the **2 separate team conceptual solution designs** (with the required description + figures)

**How to write a solution design with description and figures?**

# Solution Concept to "Conceptual Design"

- **Conceptual Design**
  - Provides general or system level structures with schematics, block diagrams, flowcharts, etc, to reach at the desired solution which satisfies the design requirements
  - Provides a description of the desired system which satisfies the design requirements
  - Provides integrated ideas and concepts about how the desired system does, behaves, and responds.
  - Defines, in addition to functionality, appearance (looks).
- **How do we make a conceptual design?**
  - Any good example or case to start from?

# A good “Conceptual Design”

- **A good conceptual design should:**
  - Provide a description of a desired system which satisfies the design requirements
  - Provide integrated ideas and concepts about how the desired system behaves [functionality] and looks [aesthetics]
  - Use drawings and/or models and/or proto-types

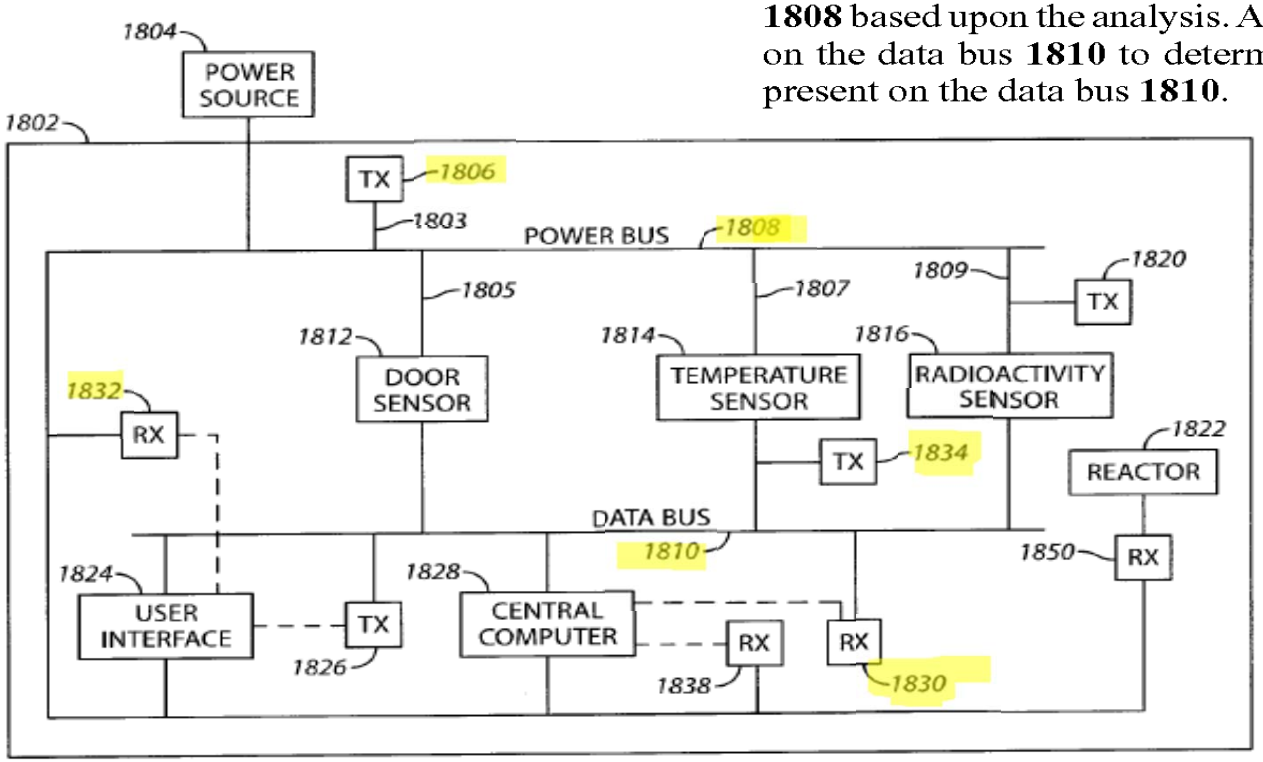
# "Conceptual Design" Examples from Patents

- **Learn from Patents for a good conceptual design**
  - Follow Patent Figures and their Descriptions using the Figures
  - How different figures (structure, logic diagram, flowchart, hardware, software, etc) are employed to describe different aspects of the concept(or idea)
- **Examples**
  - Next slides (a lot of them) will show different ways **of (1) drawing figures** (for different purposes and different elements such as structure, H/W, S/W, operation flow, network, etc) and **of (2) describing the concept using the figures**.

# Conceptual Design - Examples

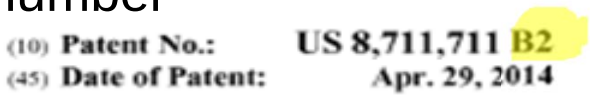
(10) **Patent No.:** **US 8,711,711 B2**
(45) **Date of Patent:** **Apr. 29, 2014**

In other aspects, a modulated signal is transmitted from the transmitter **1834** or **1806** and across the power bus **1808** that is coupled to the sensors **1812**, **1814**, or **1816**. The modulated signal is received at the receiver **1832**. The receiver **1832** analyzes the received modulated signal and determines whether an intermittent fault has occurred on the power bus **1808** based upon the analysis. A similar approach can be used on the data bus **1810** to determine if intermittent faults are present on the data bus **1810**.



# Kind Codes of USPTO

- A letter and a number which follow the patent number
- WIPO Standard ST. 16 code: “Kind Code”
- Kind codes changed in January 2, 2001




| Kind Code | Kind of Document |
|---|---|
| A1 | Patent Application Publication |
| A2 | Patent Application Re-publication |
| A9 | Patent Application Corrected-publication |
| B1 | Patent [No previously-published pre-grant publication] |
| B2 | Patent [having previously-published pre-grant publication] |
| P1 | Plant Patent Application Publication |
| P2 | Plant Patent [No previously-published pre-grant publication] |
| P3 | Plant Patent [Having previously-published pre-grant publication] |
| S | Design Patent |

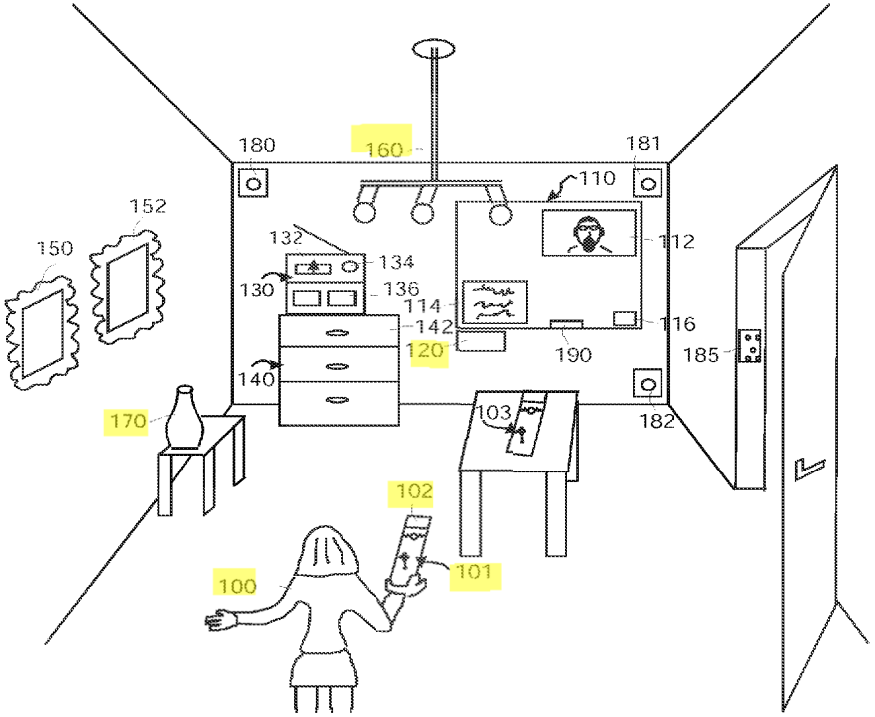
# Conceptual Design - Examples

- User Interface System Based on Pointing Device

(10) **Pub. No.: US 2014/0062879 A1**
(43) **Pub. Date: Mar. 6, 2014**

**[0049]** According to the invention, the pointing device **101** contains a camera **102**, and can send pictures of regions of a room or objects in those regions to a digital signal processor (DSP) **120**, which can identify the regions or objects on the basis of one or more pictures imaged by the camera **102**. The camera is connected to the pointing device **101** in such a way, that it images well the region pointed to. E.g. it can typically reside at the far end of the pointing device **101**, but it could also be mounted on the side under an angle. The user **100** has the freedom to point to whatever object he wants, and in such a way a very user-friendly and powerful user interaction system can be realized.

**[0051]** The DSP **120** is designed to send user interface information I, e.g. apparatus control data ac, to an identified apparatus. E.g. user **100** can point the pointing device **101** to light **160** and push an on-button on the pointing device **101**, which results in the DSP **120** sending an on-command to the identified light **160**. The object identified needs not be the apparatus to be controlled itself. E.g. pointing at vase **170** may



# Conceptual Design - Examples

- Evolving light patterns in the canvas of LEDs

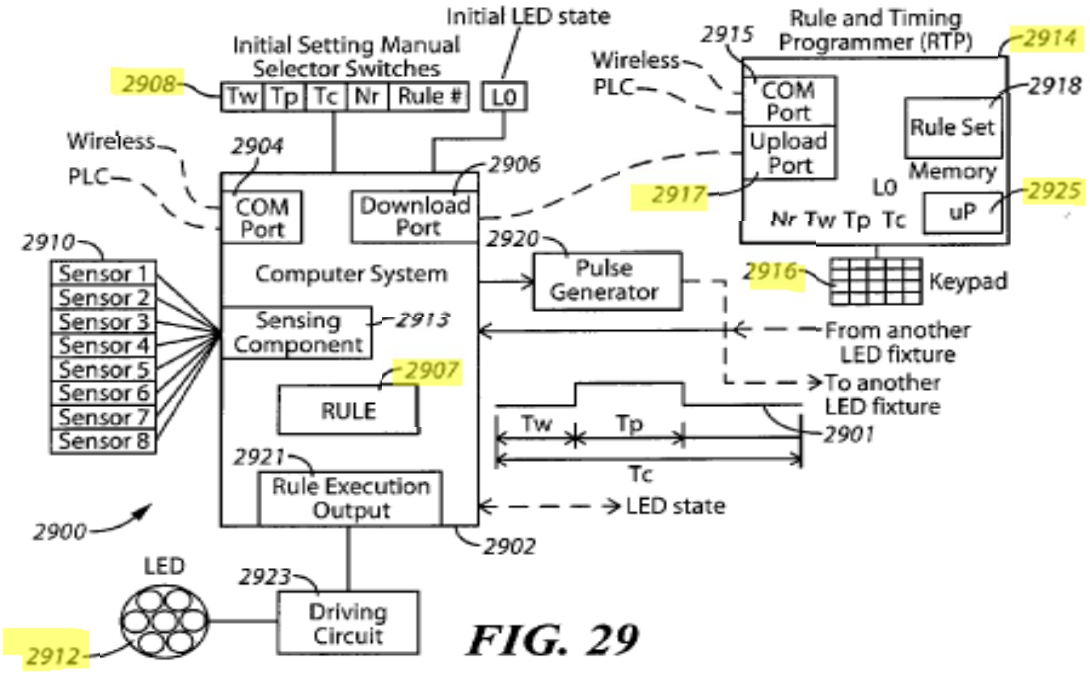



FIG. 29

The initial items can be either determined by the manual selector switches **2908** separately placed in the LED fixture or by downloaded from a Rule and Timing Programmer (RTP) **2914**, a separate system not installed in LED fixture. The RTP **2914** includes a processor **2925** and can be realized by a computer system which is capable of wired communication downloading and wireless or PLC communication of the items needed in the LED fixtures that can be typed in by a keypad **2916** attached to the RTP **2914** or available in a memory **2918** inside the RTP **2914**. The RTP **2914** includes a COM port (to receive wireless or PLC data) and an upload port **2917** (to upload information to the download port **2906**). A rule **2907** is downloaded via COM port **2904**. The information from the sensors is processed by sensing components **2913**. A rule execution output **2921** (with instructions as to how to drive the LED **2912**) drives a driving circuit **2923** that converts the instructions to electrical signals to control the LED **2912**.

Another approach for initializing the items mentioned above, whether via manual selector switches **2908** or by RTP **2914**, is to obtain the row number (Nr) and a table of the row number and the timing pulse information for the row number, which is stored inside the memory of the controller and retrievable to the computer system, instead of reading them all separately. This alternative approach is advantageous if the initial setting values are to be downloaded or communicated from the RTP **2914**.

# Sign Language Interpreter

(54) **MACHINE BASED SIGN LANGUAGE INTERPRETER**

(10) **Patent No.:** **US 8,751,215 B2**

(45) **Date of Patent:** **Jun. 10, 2014**

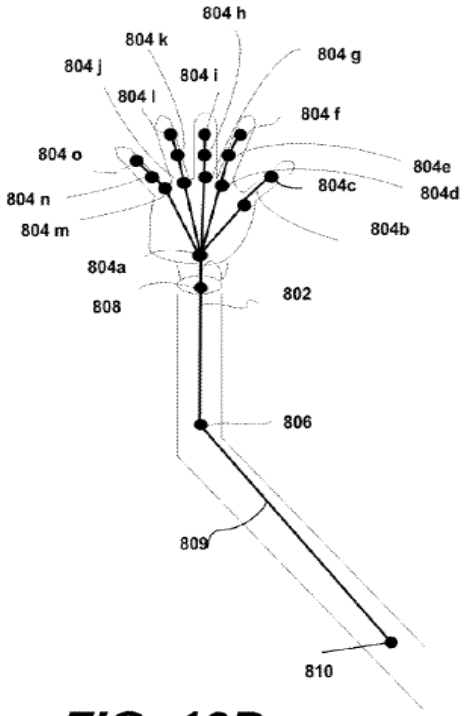



FIG. 10D

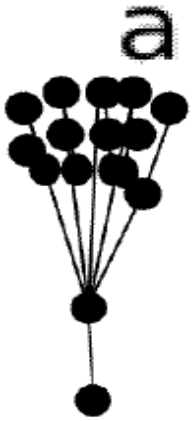



FIG. 1B

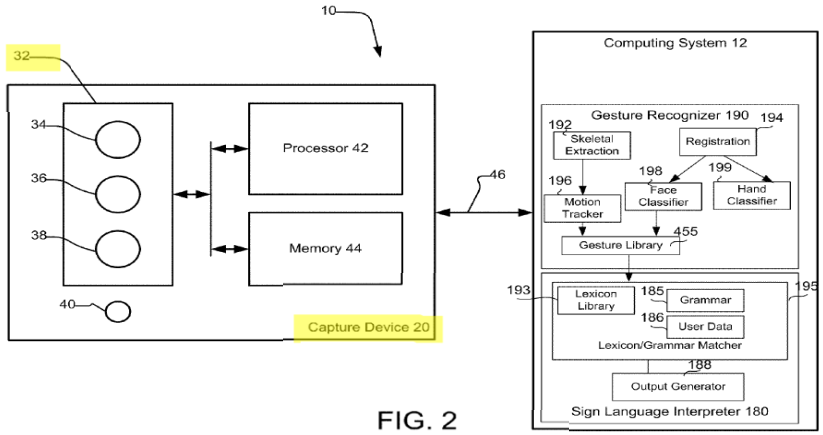



FIG. 2

As shown in FIG. **2**, the capture device **20** may include an image camera component **32**. According to an example embodiment, the image camera component **32** may be a depth camera that may capture the depth image of a scene. The depth image may include a two-dimensional (2-D) pixel area of the captured scene where each pixel in the 2-D pixel area may represent a depth value such as a length or distance in, for example, centimeters, millimeters, or the like of an object in the captured scene from the camera.

# Sign Language Translator

(54) **SIGN LANGUAGE TRANSLATOR**

(10) **Patent No.: US 8,566,077 B2**
(45) **Date of Patent: Oct. 22, 2013**

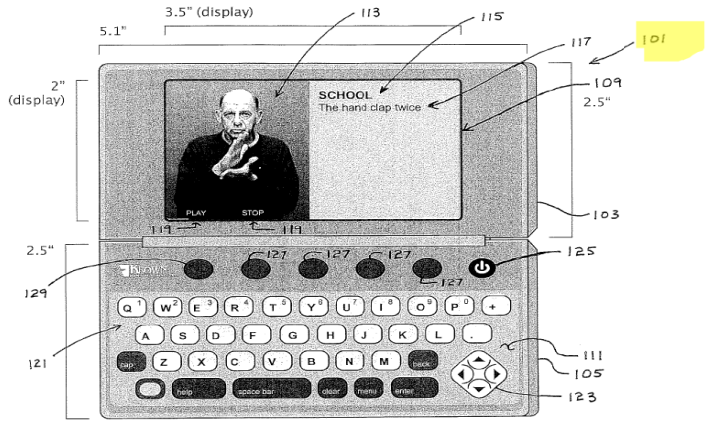



Fig. 1

Referring to FIG. **1** in the drawings, an alternative embodiment of a digital sign language translator **101** according to the present application is illustrated. In this embodiment, translator **101** is configured as a small hand-held electronic device, similar in size and shape to personal digital assistants (PDA's), cell phones, or personal organizer. As such, the functionalities of translator **101**, as disclosed herein, may be incorporated into a PDA device, such as a cell phone, smart phone, or other PDA type device. In the example of FIG. **1**,

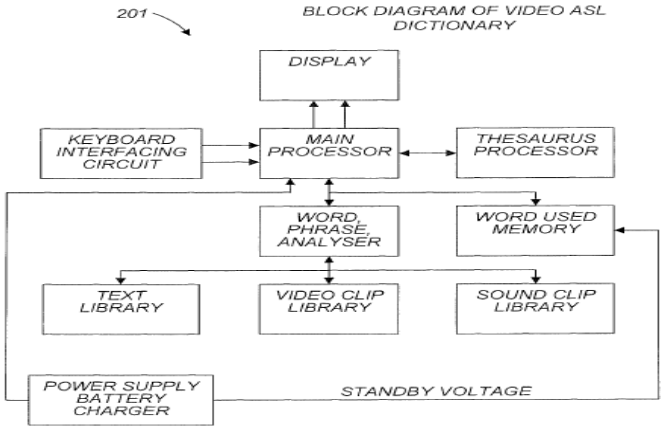



**FIG. 2**

Referring now also to FIGS. **2-4** in the drawings, a portion of the functionality of one embodiment of translator **101** is illustrated. FIG. **2** shows a high-level block diagram **201** of translator **101**, FIG. **3** shows a flowchart **301** of the dictionary feature of translator **101**, and FIG. **4** shows a flowchart **401** of the video clips of ASL feature of translator **101**.

# Describing Concepts Using Figures

- **1.In figure**, each component in a figure must have a number (marked by a number).
- 2. If the component is used in another figure, the component should keep the same number.
- 3. A **process (instead of a component)** is to be described in detail with all the components in the figure for the process numbered.
- 4**. In description**, whenever a numbered component is used, the named component must be followed by the component number.
- 5. Description must be narrative - **not** a bulleted item. Complete sentences and paragraphs are to be used as in a technical paper or an essay.

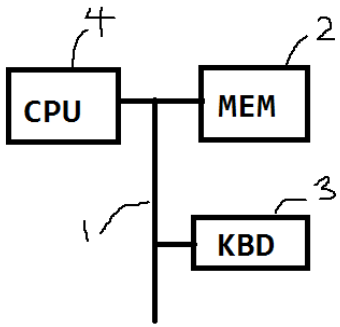
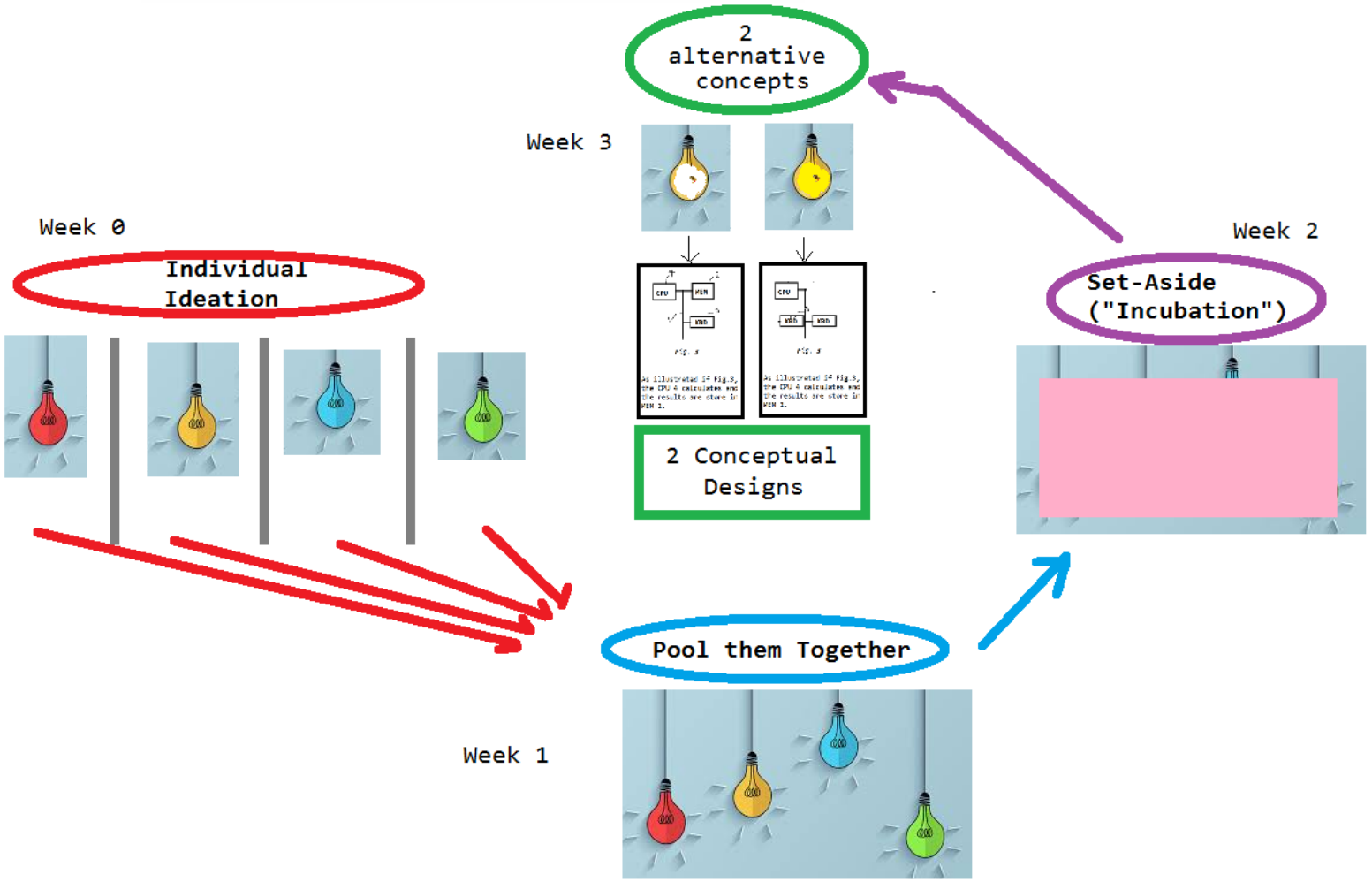



*Fig. 3*

As illustrated in Fig.3, the CPU 4 calculates and the results are store in MEM 2.

# Recap: Team Conceptual Design Process



# Timeline

| Date | Activities |
|---|---|
| Week of Oct 22 - 28 | 1. From **today**, each member individually generates a solution concept/idea.<br>2. **Bring it to a weekly team meeting**<br>**3. Discuss the individual concepts/ideas in the team meeting** |
| | Incubation period – 1 week |
| Week of Oct 29 – Nov 4 | Team meeting<br>• Discuss individual ideas and develop into **2 team Solution Concepts/Ideas**<br>• Describe [type] the ideas with figures to **2 conceptual designs**. |
| W 11/8/2017 | Submission of (1) all individual concepts/idea**s** and (2) (2a) Team Conceptual Design #1 (2b) Team Conceptual Design #2 |
| W 11/15/2017 | Submission and **Presentation** of the ***Analysis of 2 designs and Selection of the Top Design*** |
| W 11/29/2017 | **Presentation** of **Solution and Conceptual Design** |