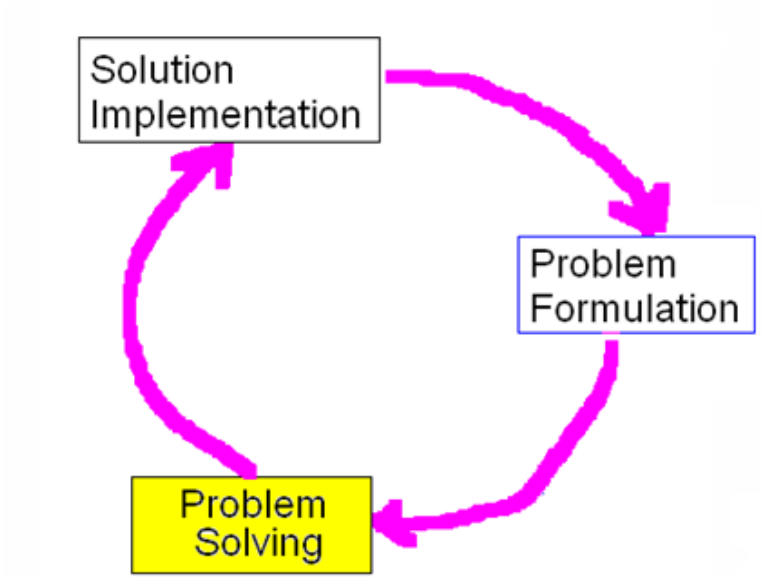
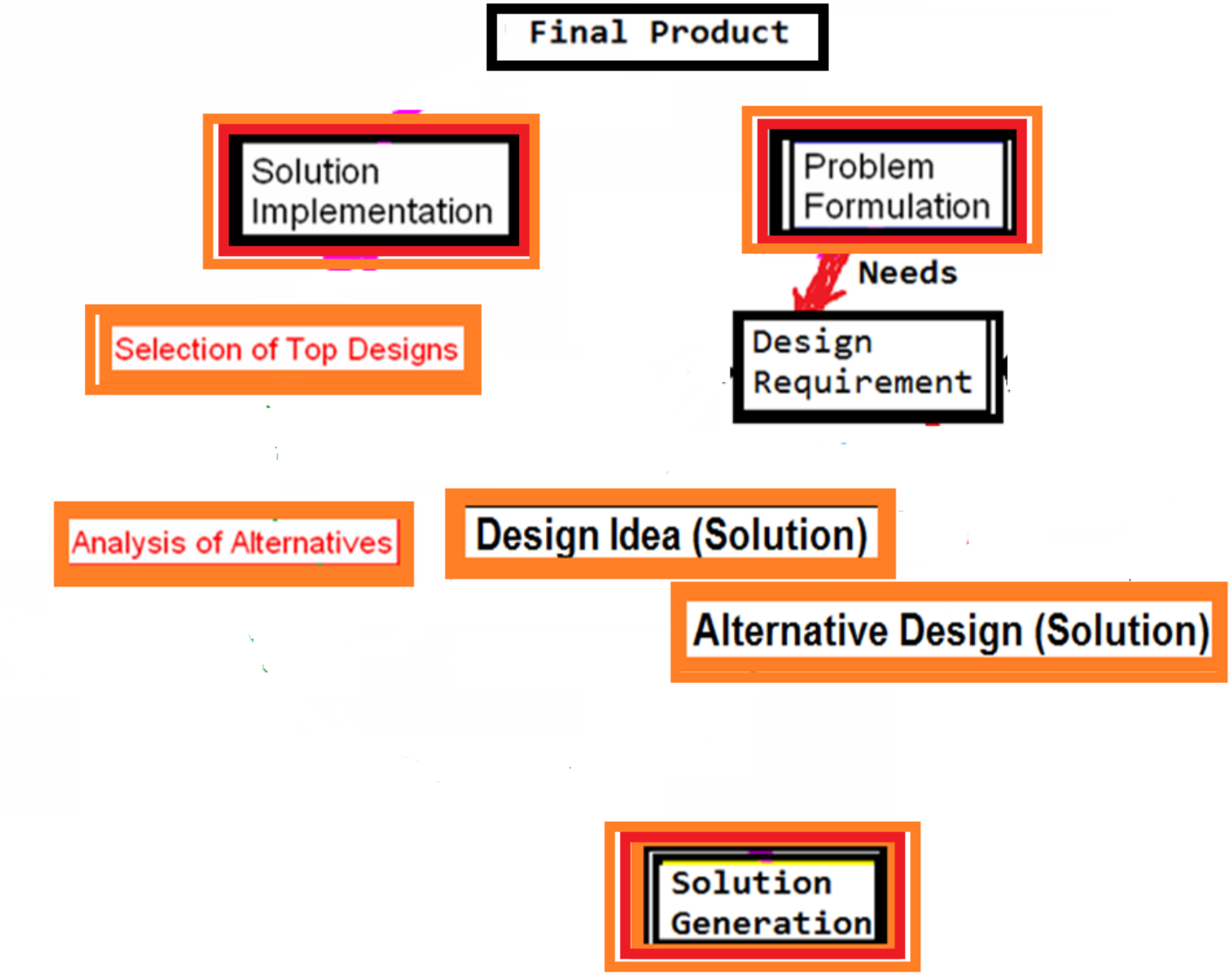
Problem Solving = Solution Generation

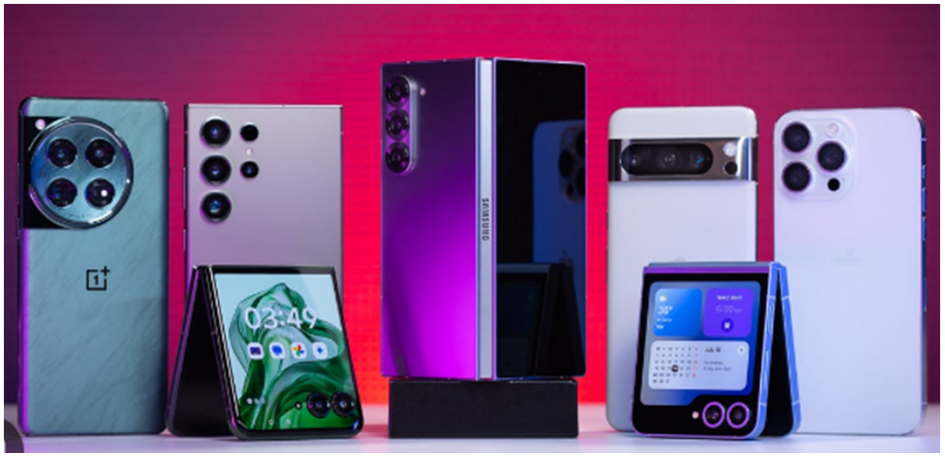


- Background:
  - ( ) was defined
  - ( ) were quantified
- Objectives:
  - –Solution Generation **Steps**

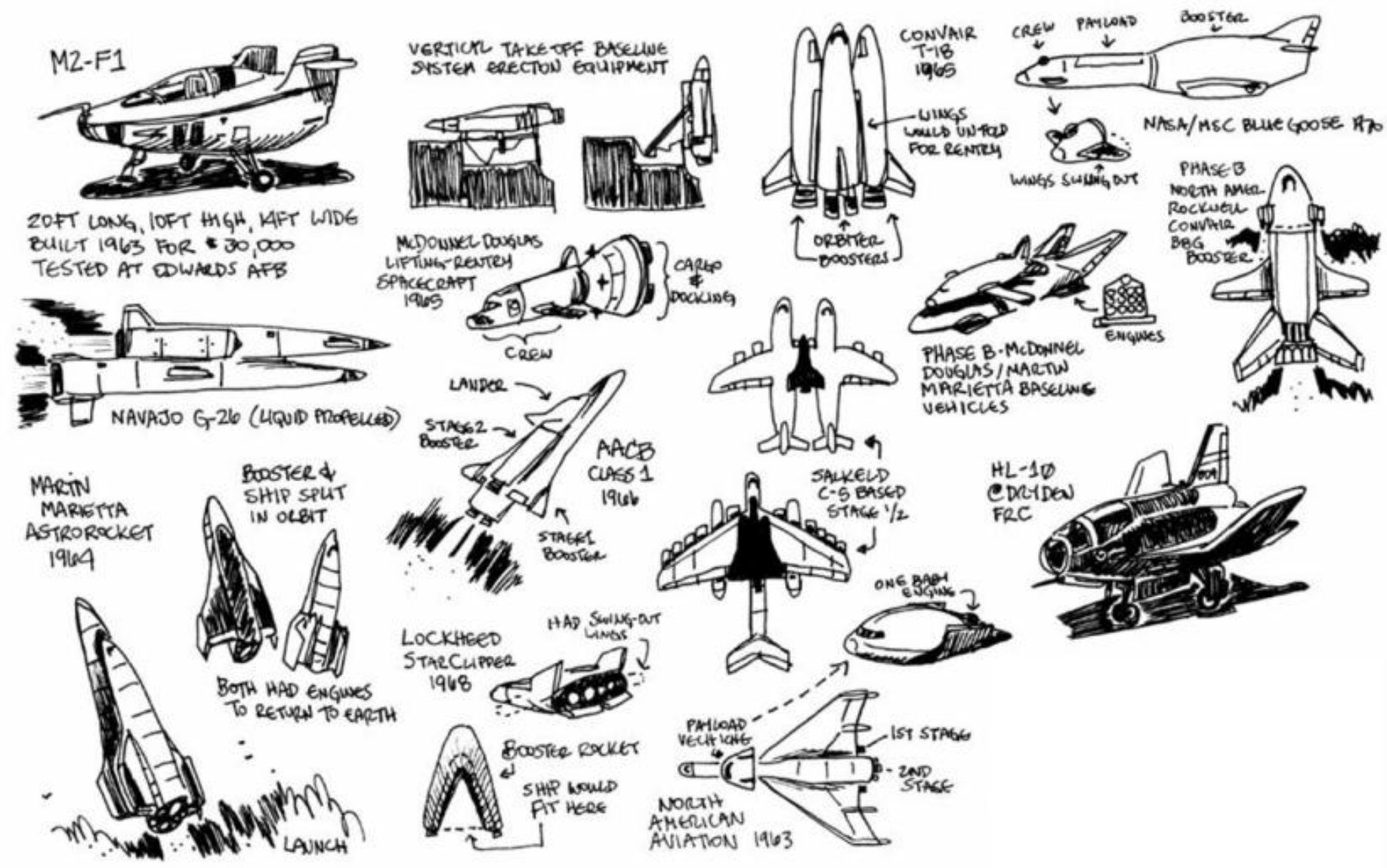
Solution Generation



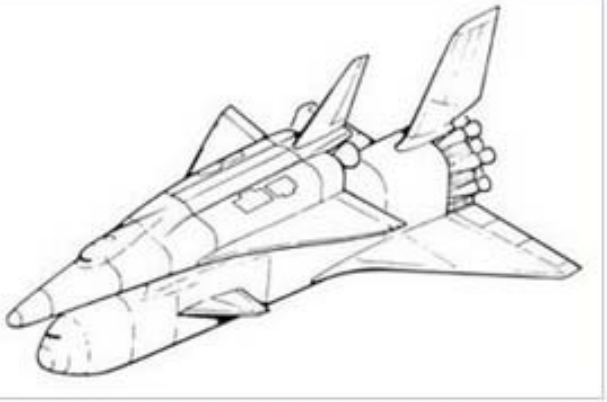
Solutions and Alternatives Solutions



Remember the different designs of space shuttle?
(**Conceptual designs**)

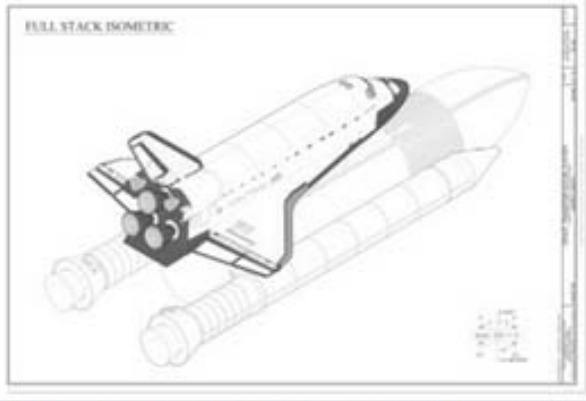


Remember the different designs of space shuttle?



Original North American Rockwell Shuttle delta wing design, 1969: fully reusable, with a flyback manned booster

Maxime Faget's DC-3 concept employed conventional straight wings.

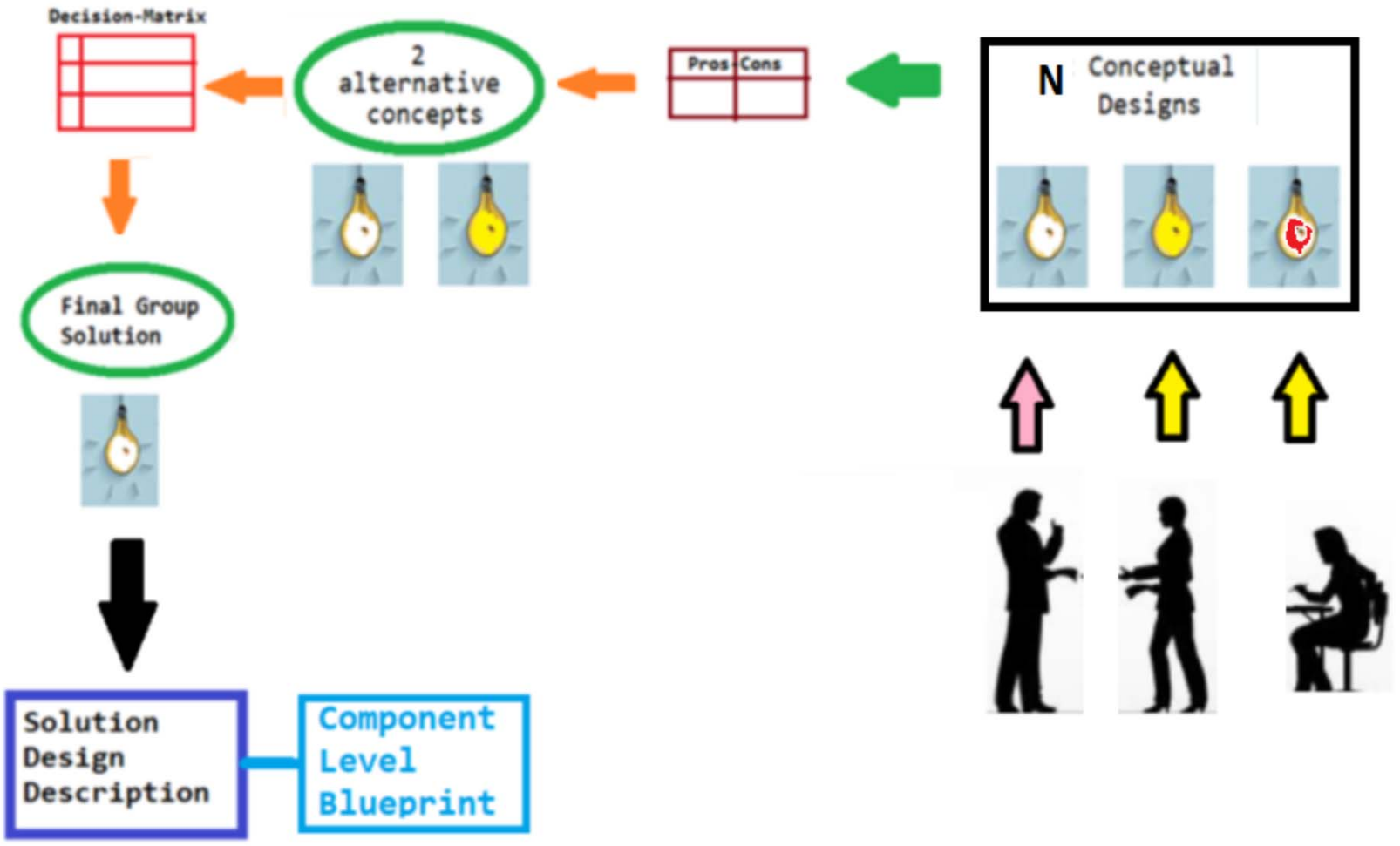


Final semi-reusable design with throwaway external fuel tank and recoverable solid rocket boosters

Solution Generation - Essence

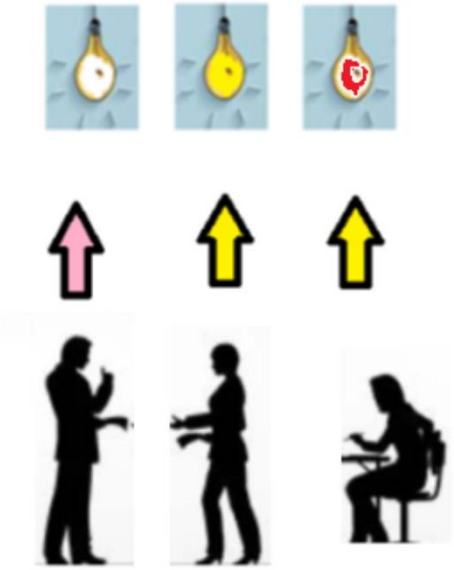
1. Start from ( )
2. Expand the solution space (or think more and explore more) and come up with ( ) solution designs: Practical Approach → Each member generates one's own idea
3. ( ) the solution designs using pros & cons ("qualitative") comparison
4. Select one of the designs as the ( ) solution design using decision matrix ("quantitative")
5. Draw a ( ) schematics of the top design

Practical solution generation approach



Team Activity -- **"Solution Generation" – STEP 1**

- **STEP 1: Give assignment to each member to bring up a Solution Design** – each member works separately without discussion with other members
  - Remember: Each solution should satisfy the ( )
  - Each member writes and sketches his/her solution idea and should be ready to bring it to the next team meeting.
  - **Step 1 deliverable**:
    - **A solution design from each member**



Team Activity -- **"Solution Generation" – STEP 2**

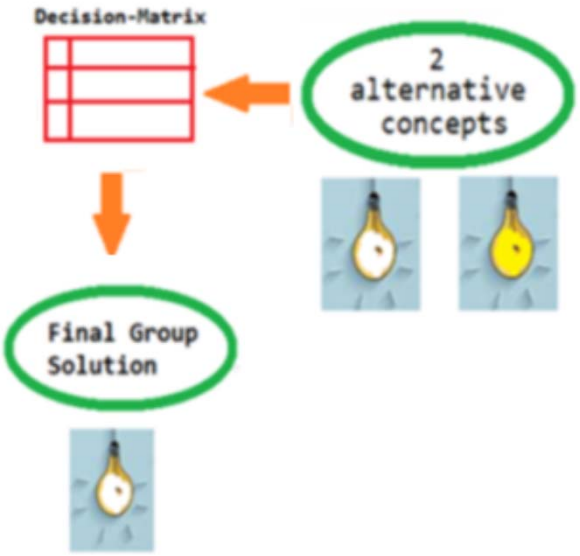
- **Step 2: Analysis -** Hold a team meeting to discuss the solution designs/ideas/sketches from all the members.
  - Discuss on the concepts/ideas/designs
  - Analyze the details of the solution designs
    - Qualitative Analysis: Pros & cons
  - Select 2 better ideas among the solutions
  - **Step 2 deliverables:**
    - **Pros & cons table**
    - **Selected 2 design solutions**

Pros & Cons Table - Example

Solution Ideas	Pros	Cons
Student1: New ready-made frame based robot and new sensors and processors	• Use of ready-built frame saves time • No need of 3-D printer	• May not compatible with existing motors. • Controlling code and installation would face difficulties
Student 2: Reuse of the last year's robot frame and sensors and processors	• Recycling the pervious frame would save time and ease installation of parts and components	• Issue with the control code availability and revision compatibility
Student 3: Use 3-D printed robot frame with sensors and processors	• Customized frame would ease the installation of components and parts would be easier.	• Issue with 3-D printing experience or helps • It may consume unexpectedly long time.

Team Activity -- **"Solution Generation" – STEP 3**

- **Step 3 : Selection of the Top Design Solution** for the project from the 2 designs
  - Top Design Selection is decision-making process
    - Quantitative Analysis: Decision-Matrix
      - **Attributes**
      - **weight**



  - **Step 3 Deliverables:**
    - **Decision Matrix**
    - **Brief Description on the basis of assigning different weights on different attributes**
    - **Selected top design solution**

Decision Matrix

- Decision-making involves making trade-offs
  - The results of the analysis
  - Satisfaction of the Design requirements
  - Use Decision Matrix
    - **Attribute** and **weight**
    - Selection Criteria: which is more important in making decision?

EXAMPLE

Purchase of a used car

CAR	COST	ODOMETER READING	MECHANIC'S RATING (1 - 10)	LOOKS (1 - 10)
RED	$2000	150,000	7	5
BLACK	$2500	140,000	5	6
BLUE	$3000	120,000	8	8

10: Best
1: Worst

Decision Matrix - Example

Purchase of a used car

CAR	COST	ODOMETER READING	MECHANIC'S RATING (1 - 10)	LOOKS (1 - 10)
RED	$2000	150,000	7	5
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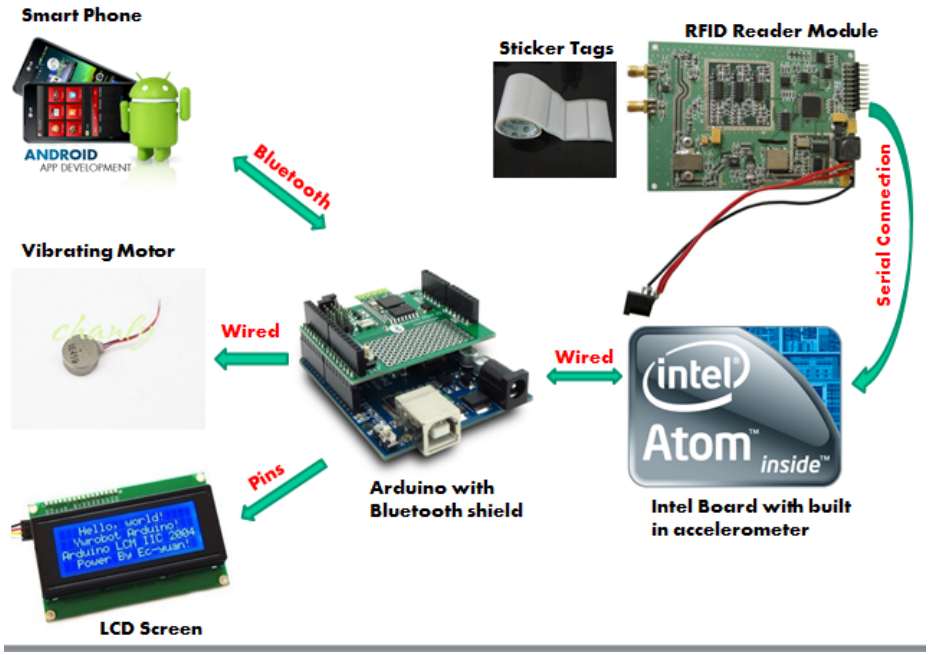
10: Best
1: Worst

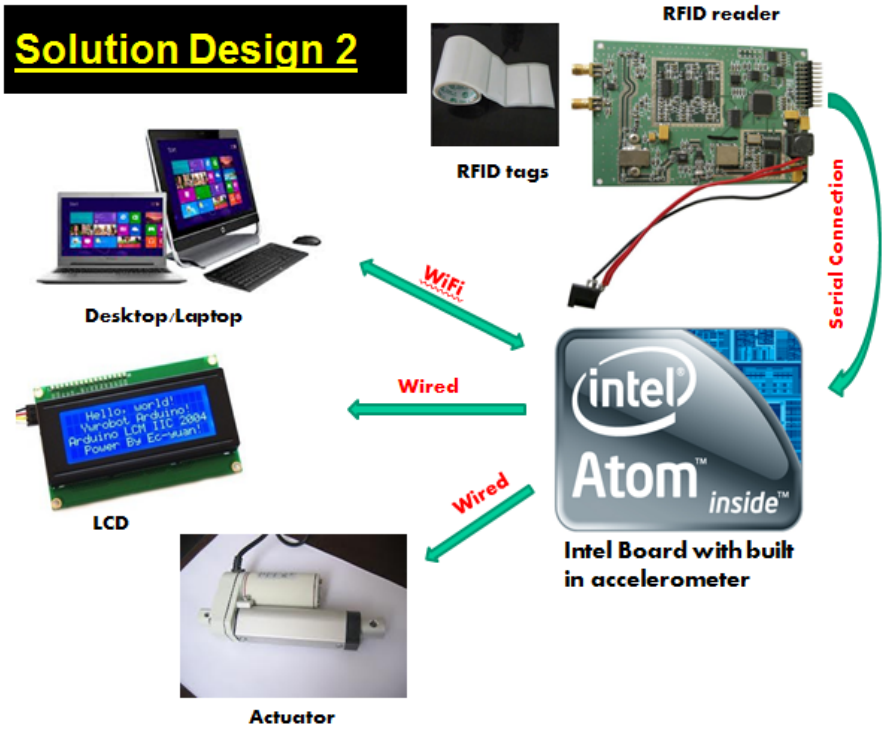
	Cost	Cost **Wt**	Odometer	Odo **Wt**	Engine	Engine **Wt**	Total Score	
RED	5	0.5	2	0.2	4	0.3	**4.1**	X
BLACK	4		3		3		**3.5**	
BLUE	3		5		5		**4.0**	

Decision Matrix - Example

Solution Design 1



Solution Design 2



2013 Intel-Cornell Cup Competition: team **Smart Backpack**

Design Decision Matrix

	Wt	Design 1	Score	Agg. Score	Design 2	Score	Agg. Score
Functionality	5	Smartphone Arduino Vibrating motor	5	**25**	Desktop Actuator	3	**15**
Connectivity	2	Bluetooth Wired Wi-Fi	5	**10**	Wired Wi-Fi	3	**6**
Weight	3	Approx. 940g	4	**12**	Approx. 890g	5	**15**
Power	4	More components to be powered	3	**12**	Fewer components to be powered	5	**20**
Convenience	1	On the go edit	5	**5**	At home edit	3	**3**
TOTAL				**64**			**59**

Team Activity -- **"Solution Generation" - STEP 4**

- **Step 4: Write Solution Design Description**
  - **Description** of the Top Solution Design
- **A good Solution Design Description should:**
  - Provide integrated ideas and concepts about how the desired system behaves [functionality] and looks [aesthetics]
  - Use drawings and/or models and/or proto-types
  - **"Describe with at least 1 figure"**
- **Step 4 Deliverables:**
  - **Description of the Top Solution Design**

How to write a solution design with description and figures?

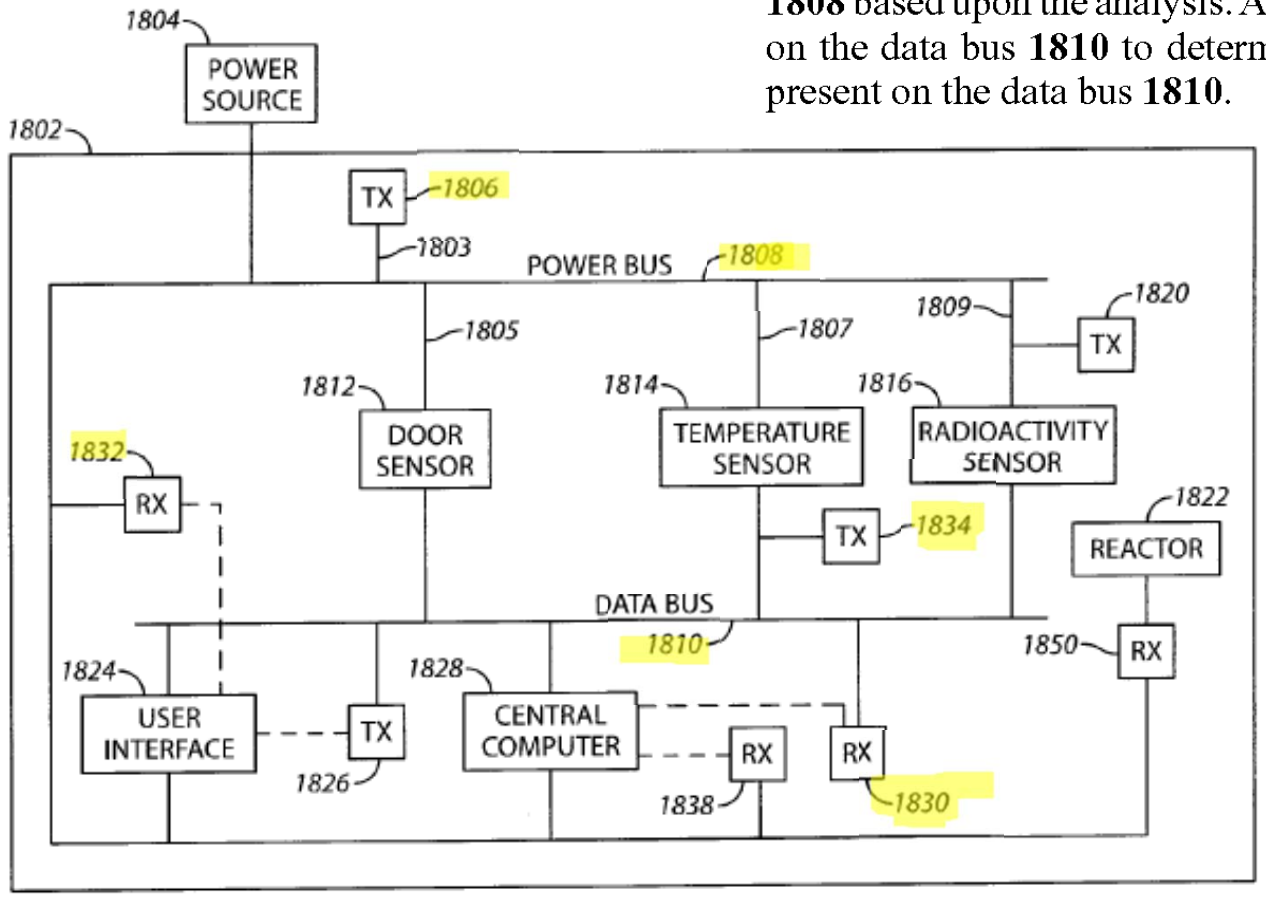
"Solution Design Description" – We follow **Patent Description**

- **Learn from Patents for a good solution design description**
  - Follow Patent description: Figures and their Descriptions using the Figures
- **Examples**
  - **Next** will show different ways **of (a) drawing figures** (for different purposes and different elements such as structure, H/W, S/W, operation flow, network, etc) and **of (b) describing the solution design using the figures**.

Solution Design Description- 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**.



Solution Design Description- Examples

- First Touch display patent

United States Patent Office 3,482,241 Patented Dec. 2, 1969

1

3,482,241
TOUCH DISPLAYS
Eric Arthur Johnson, Malvern, England, assignor to Minister of Aviation in Her Britannic Majesty's Government of the United Kingdom of Great Britain and Northern Ireland, London, England
Filed Aug. 2, 1966, Ser. No. 569,731
Claims priority, application Great Britain, Aug. 5, 1965, 33,524/65; June 28, 1966, 28,883/66
Int. Cl. G09b *13/00*; H05b *41/00*; G06k *1/00*
U.S. Cl. 340—337 7 Claims

2

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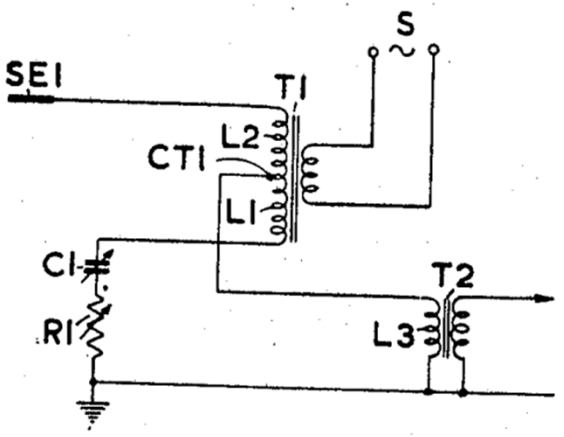


FIG. 1

Inventor
Eric Arthur Johnson
By
Cushman, Darby & Cushman
Attorneys

In FIGURE 1 the primary winding of a transformer T1 is fed from a high frequency source S (say 3000 cycles per second) and the secondary winding is centre-tapped. One half L1 of the secondary winding is connected bteween the centre tap CT1 and a terminal connected to earth via a variable capacitor C1 and a variable resistor R1 in series and the other half L2 of the secondary winding is connected between the centre tap CT1 and a sensitive electrode SE1. The centre tap CT1 is connected to earth via the primary winding L3 of a transformer T2.

The action of the circuit is as follows. The windings L1 and L2, together with the capacitor C1 and the resistor R1, and the self capacity of the sensitive electrode SE1 form a bridge circuit which is adjusted to be balanced at the frequency f_0 of the source S. When the sensitive electrode SE1 is touched by an operator the capacitance to earth presented to it is sufficient to throw the bridge off balance and an alternating potential appears across the winding L3 and hence a signal appears in the secondary winding of the transformer T2.

Solution Design Description- Examples

FIGURE 3 is a circuit diagram of part of an alternative display incorporating a touch-sensitive system. In this display a matrix **M1** of pairs of sensitive electrodes such as **SP1** is arranged on the display. All the upper electrodes of each row are connected together to a positive voltage source via a common resistor such as **R11** and all the lower electrodes of each column are connected together to earth via a common resistor such as **R21**. The terminals remote from the positive voltage source of the resistors (such as **R11**) associated with the upper electrodes are connected to separate leads in a bundle **L1** and the terminals remote from earth of the resistors (such as **R21**) associated with the lower electrodes are connected to separate leads in a bundle **L2**.

When a pair of electrodes (such as the pair **SP1**) is touched by an operator a current will flow and this may be detected both by a voltage drop at the terminal remote from the positive voltage source of the corresponding resistor (such as **R11**) connected to the positive voltage source and a voltage rise at the terminal remote from earth of the corresponding resistor (such as **R21**) connected to earth. This rise and fall in voltage may be amplified, inverted and/or otherwise manipulated in a known manner and a series of known gates connected between pairs of wires of which one is from the bundle **L1** and one from the bundle **L2**. By this way which pair of wires has been touched may be determined exactly.

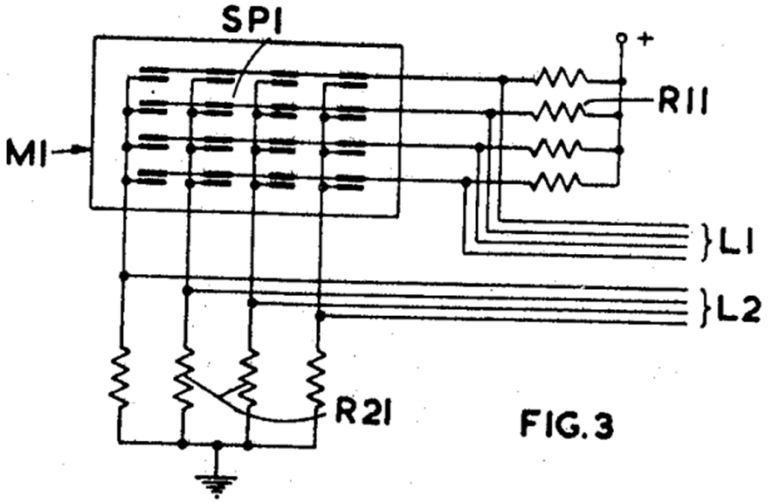


FIG. 3

Inventor
ERIC ARTHUR JOHNSON
By
Cushman, Darby & Cushman
Attorneys

Solution Design Description – "How To"

- **1.In figure**, each component in a figure must have a number (marked by a number).
- 2. **In description**, whenever a numbered component is used, the named component **must be followed by the number attached to the component**.
  - **Description must be descriptive** - **not** bullet itemized. **Complete sentences** and paragraphs are to be used as in technical paper or essay.
  - Example: "As illustrated in Fig.3, any data inputted by keyboard **3** is fed through the bus **1** to the CPU **4**, where the calculation is performed. The results from the CPU **4** is stored in the memory **2**."

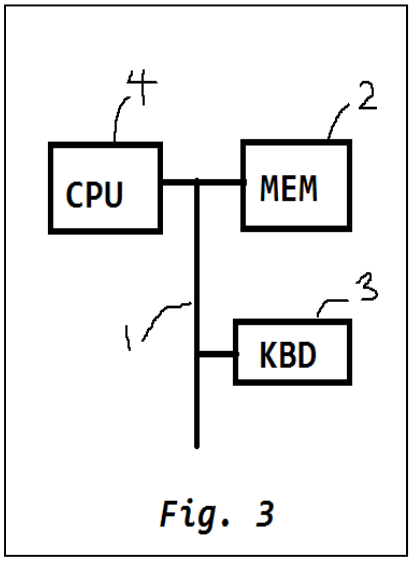


Fig. 3

Description (Example from team Backpack)

A stationary positioning of the Backpack **1** as determined by the accelerometer **2** will keep the RFID Reader **3** in standby mode. When motion is detected, the reader **3** will scan for the RFID tags **4**, which are attached to the devices, in the reading range. The reading result is provided to the Intel Atom processor **5** and the processor **5** makes a comparison with the expected tag reading. A mismatch found by the processor **5** between what is expected and what is actually read will trigger the vibrator **6** of the backpack, display the name of the missing items on the LCD screen **7**, and simultaneously notify on the user's phone **8**.

Description - Practice (team work)

Q) Rephrase the following statement as a patent-style document (description + figure)

Submission – Required

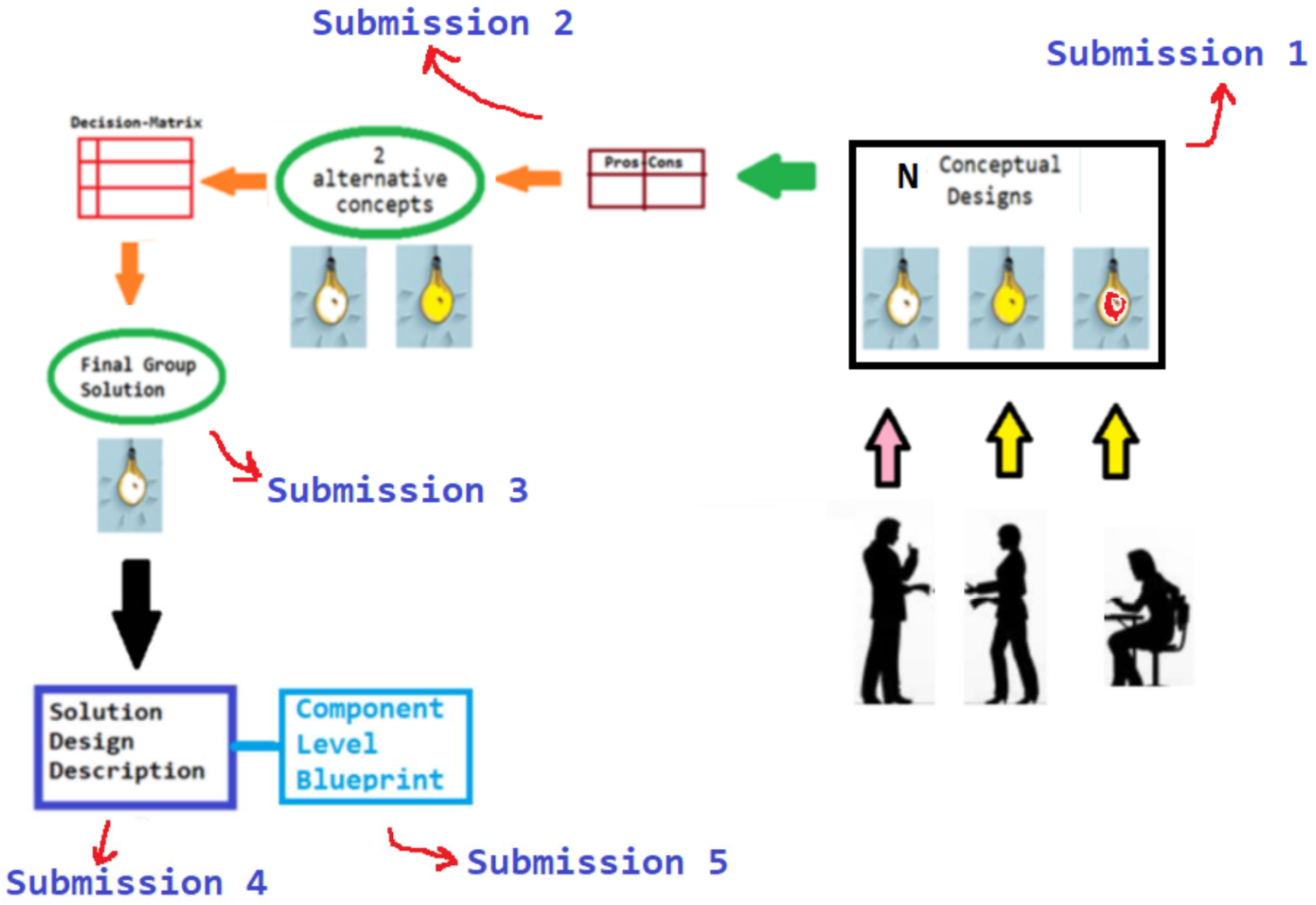
Statement: A case for a smart phone incorporates an extended rod for use as a selfies stick and includes a recess in which the telescopic rod locates when not in use. Typically, the rod includes at least one hinge about which it can pivot.

Team Activity -- **"Solution Generation" – STEP 5**

- **Step 5: Component-Level Blueprint**
  - This is the blueprint for implementation of the solution using hardware components
  - Selection of hardware components for the solution
  - Start with schematic diagram of the hardware components
  - Find a specific part for each hardware component
  - Make out a list file which shows all the parts, web link to the part store, unit price, quantity, total price.
  - **Step 5 Deliverables:**
    - **Component-level schematic diagram of the final product**
    - **Component list which, for each component, includes:**
      - **Part store (web) address**
      - **Unit price**
      - **quantity**

Submission requirements for **"Solution Generation"**

- **Submission due dates: TBD**



Team Activity Timeline and Milestones

	Activity milestones
A	1) Solution ideas from each of the members are collected. 2) The ideas compared using Pros & Cons table 3) Select 2 better ideas **4) Submit** the Step 1 and Step 2 Deliverables
B	1) In selecting 1 out of 2 ideas, consider attributes and their weights 2) Make out a decision matrix 3) Find the higher score solution as the top design of the team **4) Submit** the Step 3 Deliverables
C	1) Describe the Top solution design practicing the Patent Description model **2) Submit** the Step 4 Deliverables
D	1) From the Top Solution Design, draw a component-level schematics 2) Find and search component parts for the schematics 3) List the components **4) Submit** the Step 5 Deliverables
E	**Presentation** of Solution Design