

The Engineering Design Process

Part 3 – Concept Generation and Evaluation

MET 352

February 1, 2019

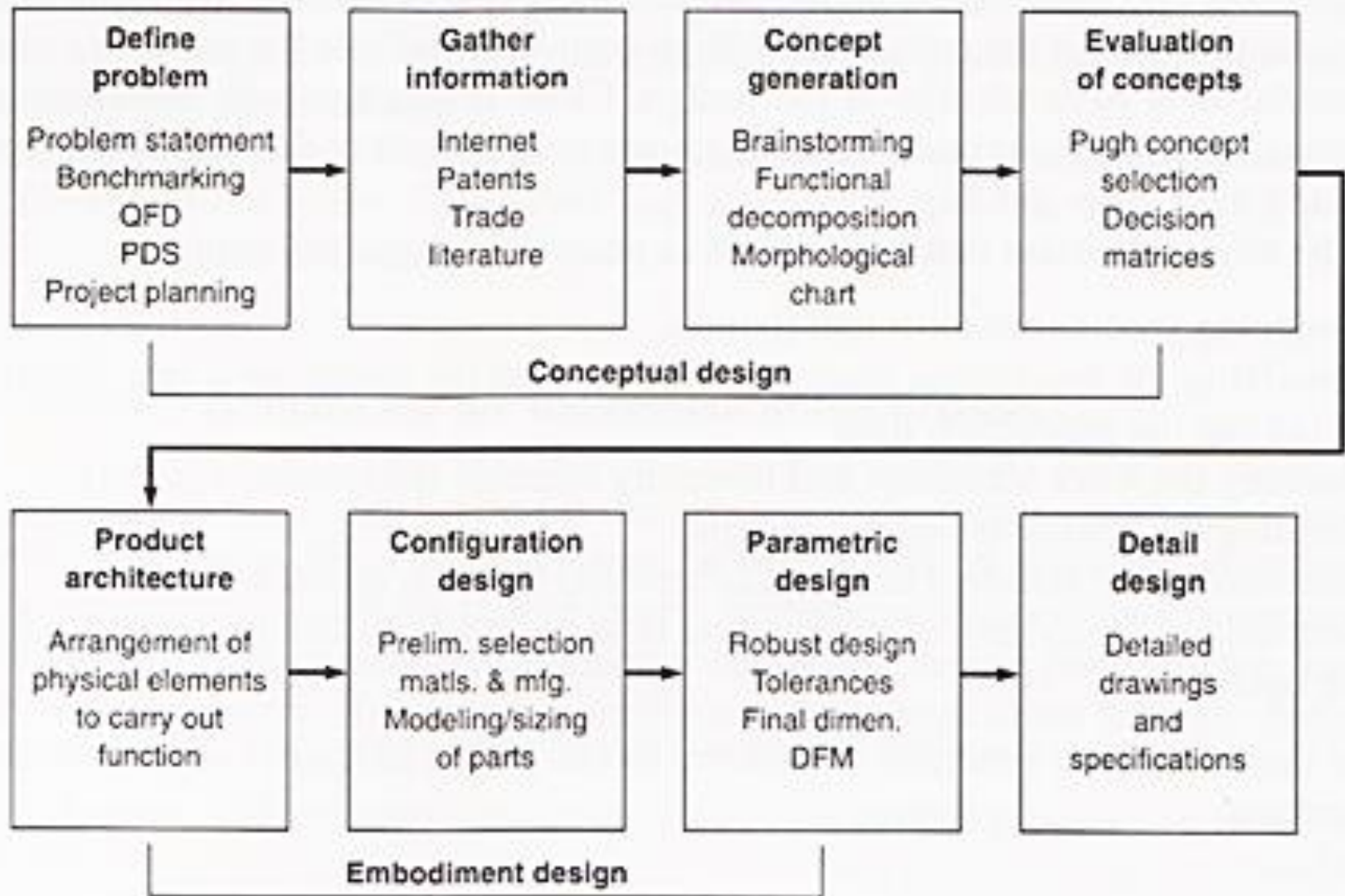
Concept Generation and Evaluation

- What is concept generation and evaluation?

Dieter and Schmidt: An intuitive way to proceed to a feasible design solution

Using creative thinking methods and design processes to assist in the synthesis of new products not previously imagined

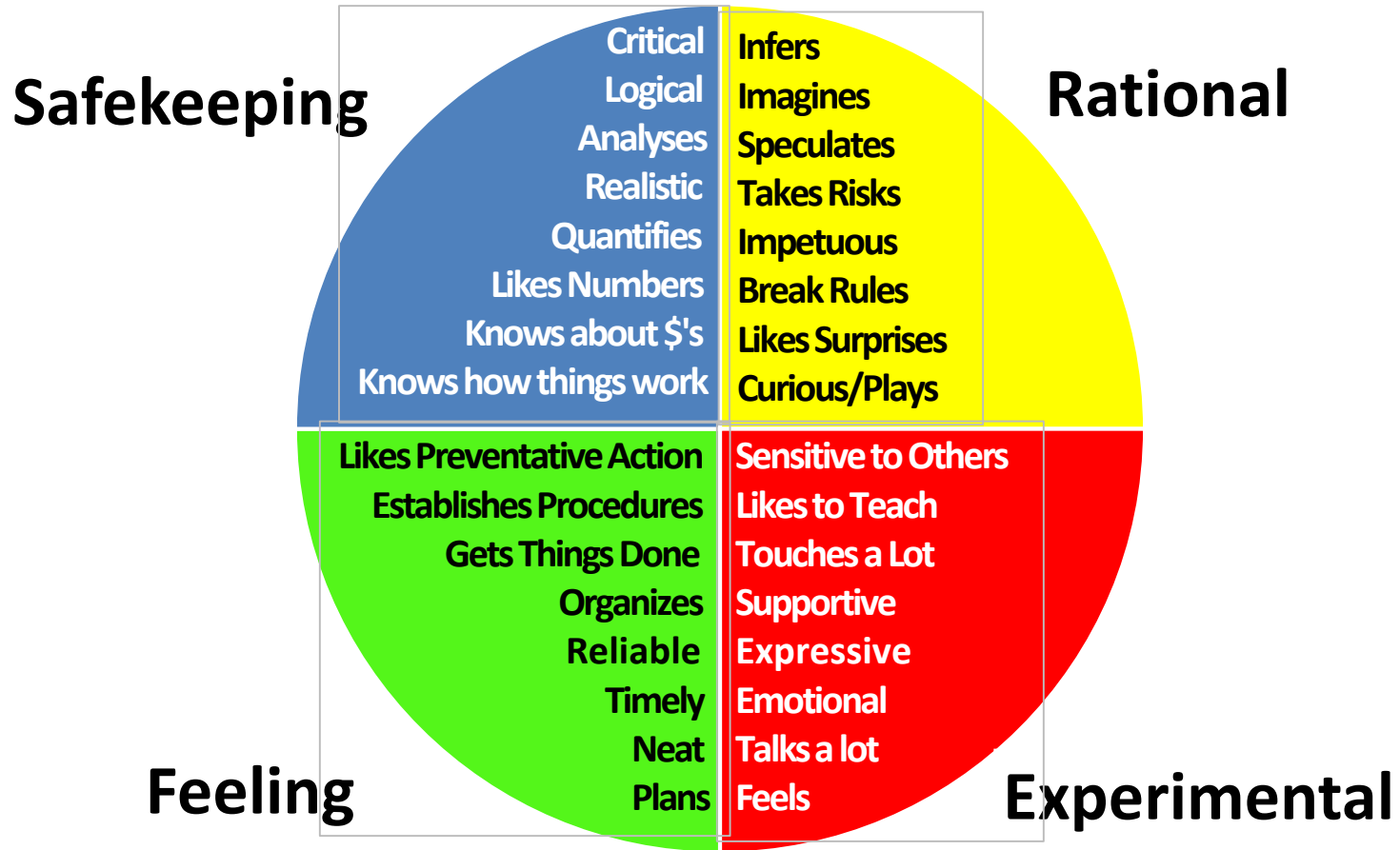
Concept Generation and Evaluation



Concept Generation and Evaluation



THE FOUR SELVES



Safekeeping

Critical
Logical
Analyses
Realistic
Quantifies
Likes Numbers
Knows about \$'s
Knows how things work

Rational

Infers
Imagines
Speculates
Takes Risks
Impetuous
Break Rules
Likes Surprises
Curious/Plays

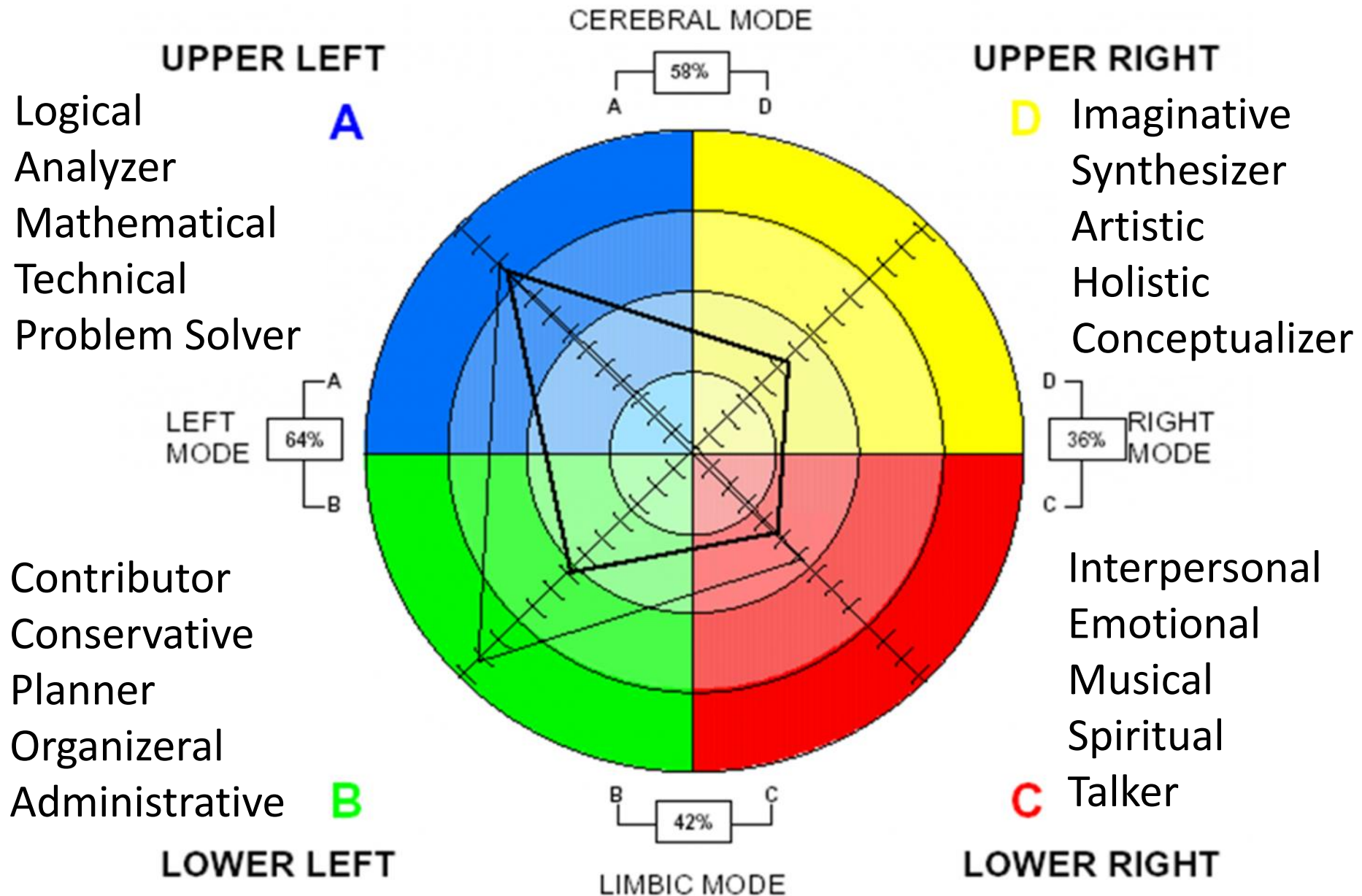
Feeling

Likes Preventative Action
Establishes Procedures
Gets Things Done
Organizes
Reliable
Timely
Neat
Plans

Experimental

Sensitive to Others	Likes to Teach
Touches a Lot	Supportive
Expressive	Emotional
Talks a lot	Feels

Concept Generation and Evaluation



Concept Generation and Evaluation

Four-Step Model (Dieter & Schmidt)

- Preparation
- Incubation
- Inspiration
- Verification

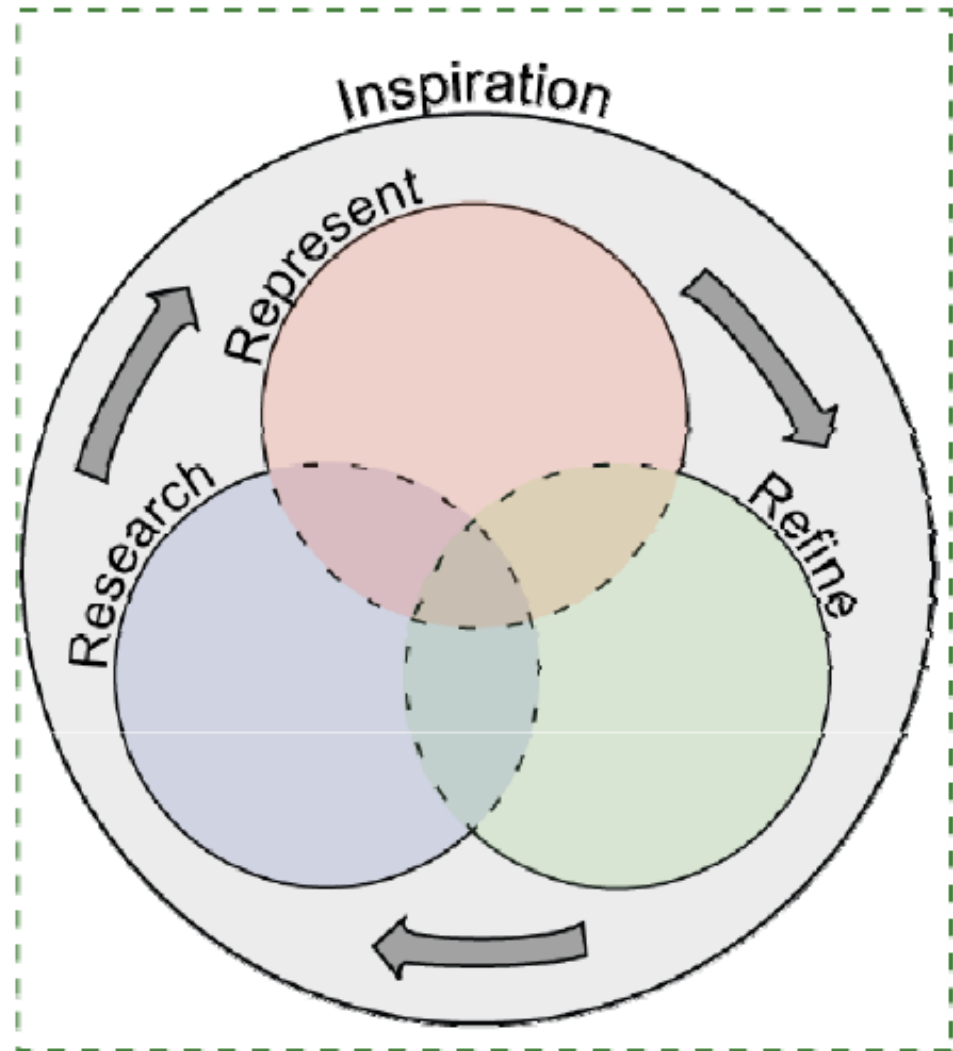


Figure 3: IR³ Idea Generation Process Model

Idea Generation Techniques among Creative Professionals

Scarlett R. Herring, Brett R. Jones, Brian P. Bailey, Proceedings of the 42nd Hawaii International Conference on System Sciences - 2009

Techniques

- **SCAMPER (Dieter & Schmidt)**
 - **Substitute**
 - **Combine**
 - **Adapt**
 - **Modify, magnify, minify**
 - **Put to other uses**
 - **Eliminate**
 - **Rearrange, reverse**

Techniques

- **Brainstorming**
- **Active Search**
- Role Playing
- Attribute List
- **Collaborate**
- Concrete Stimuli
- **Critique**
- **Documenting**
- **Expert Opinion**
- Empathy/User Research
- Encompass
- **Passive Search**
- Forced Analogy
- Incubate
- Prototyping
- Reflect
- **Sketching**
- Socializing
- **Storyboarding**

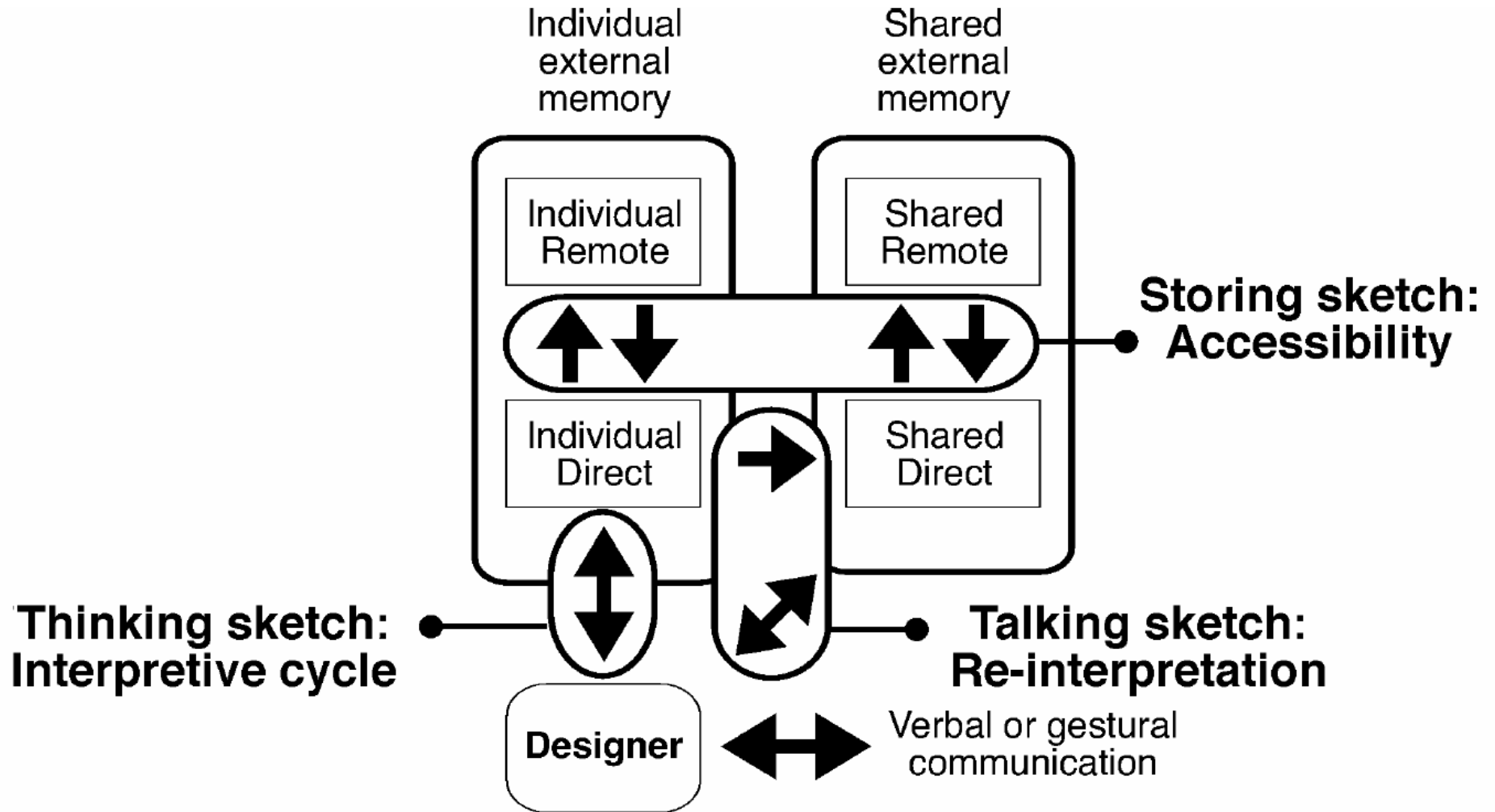
Techniques

Idea Generation Techniques among Creative Professionals

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Technique (% Referenced)	Research	Represent	Refine	Inspire
Active Search (100)	x		X	x
Attribute List (40)		x		x
Brainstorm (80)	x	x	X	x
Collaborate (60)	x	x	X	x
Concrete Stimuli (2)	x			x
Critique (90)			X	x
Documenting (60)	x	x		x
Expert Opinion(90)		x	X	x
Empathy/ User Research (80)	x			x
Encompass (50)				x
Forced Analogy (5)	x			x
Incubate (30)				x
Passive Searching (60)				x
Prototyping (70)		x		x
Reflect (60)	x		X	x
Role Playing (10)		x		x
Sketching (100)	x	x		x
Socialize (30)				x
Storyboarding (40)		x		x

Sketching



Creative Thinking Supports

- Creative Attitude
 - Self-Confidence
- Imagination
 - Child-like, vivid, why?, what if?
- Persistence
- Open Mind
 - Any and all sources
- Suspend Judgement
 - Difficult for engineers
- Problem Boundaries

Creative Thinking Barriers

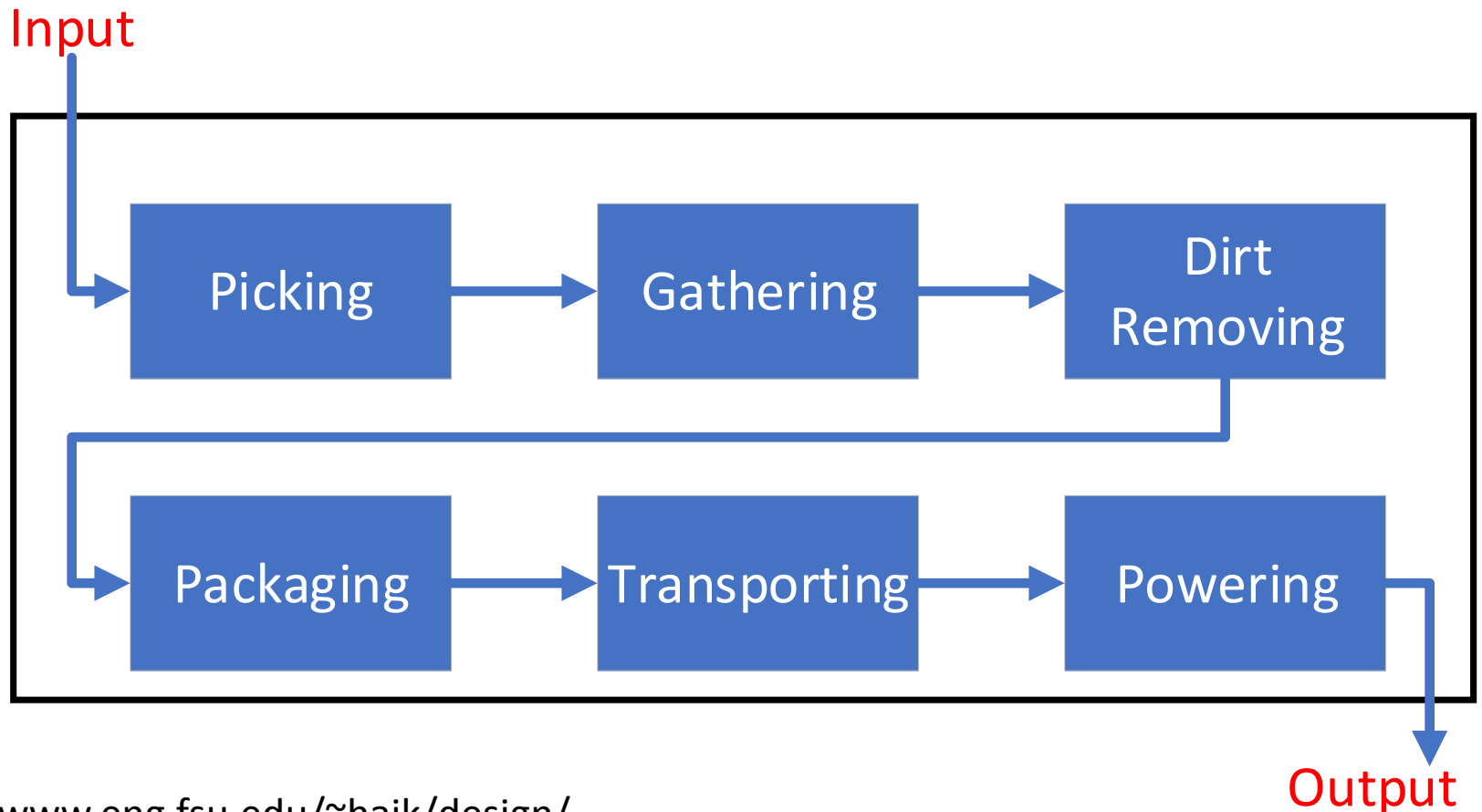
- Perceptual
 - Stereotyping
 - Information overload
 - Unnecessary limits
 - Fixation
 - Priming of cues
- Emotional
 - Fear of risk taking
 - Chaos
 - Inability to incubate new ideas
 - Motivation

Creative Thinking Barriers

- Intellectual
 - Poor problem representation
 - Memory block
 - Insufficient knowledge
 - Incorrect information
- Environmental
 - Physical environment








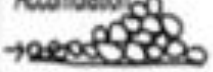

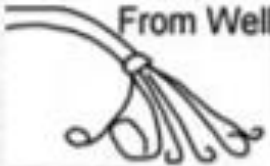

Creative Thinking Example

The function of the vegetable collection and packaging system was decomposed into six elements that satisfy the design requirements




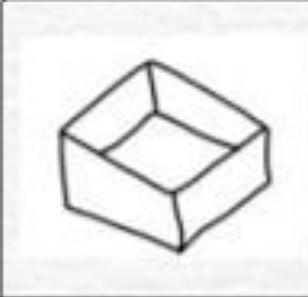



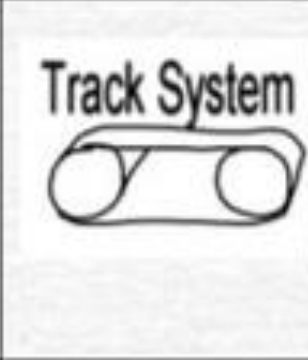

Creative Thinking Example

Morphological Chart

	Option 1	Option 2	Option 3	Option 4
Vegetable Picking Device		 Triangular Plow	 Tubular Grabber	 Mechanical Paw
Vegetable Placing Device	 Conveyor Belt	 Rake	 Rotating Mover	 Force from Vegetable Accumulation
Dirt Sifting Device	 Square Mesh	 Water From Well	 Slits in Plow or Carrier	

Creative Thinking Example

Morphological Chart (cont'd)

	Option 1	Option 2	Option 3	Option 4
Packaging Device				
Method of Transportation		Track System 	Sled 	
Power Source	Hand pushed	Horse drawn	Wind blown	Pedal driven

Creative Thinking Example

Concept Generation

Concept #1

Vegetable Picking Device = NONE

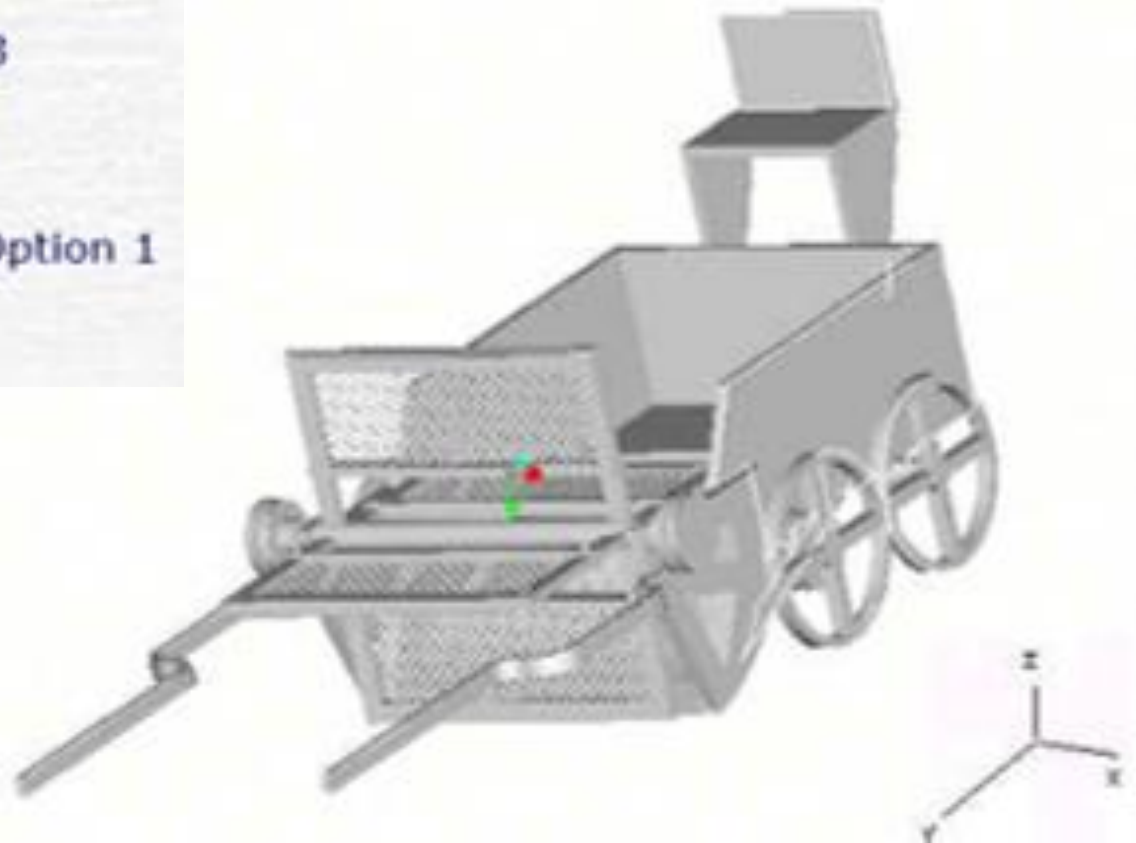
Vegetable Placing Device = Option 1

Dirt Sifting Device = Option 3

Packaging Device = Option 1

Method of Transportation = Option 1

Power Source = Option 2



Creative Thinking Example

Concept #2

Vegetable Picking Device = Option 1

Vegetable Placing Device = Option 3

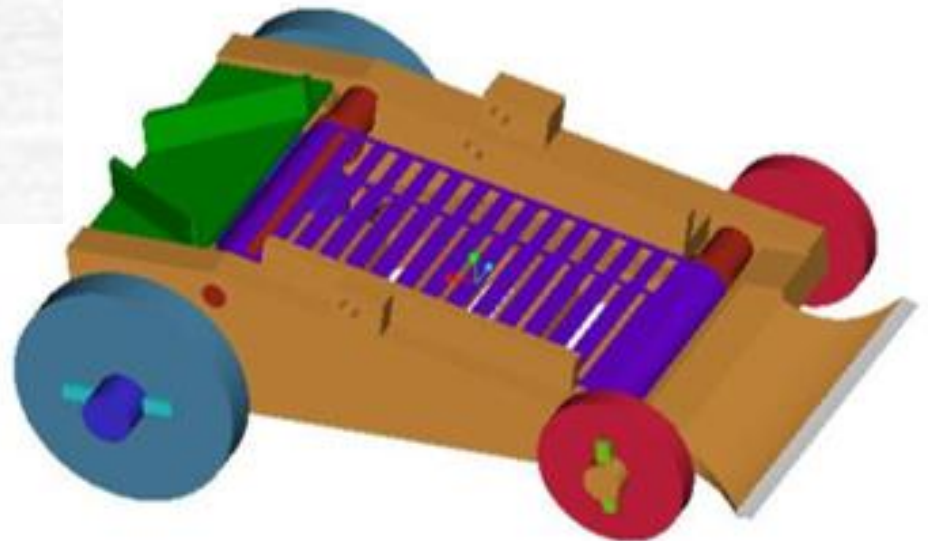
Dirt Sifting Device = Option 1

Packaging Device = Option 2

Method of Transportation = Option 1

Power Source = Option 2

Note: An option may be used in multiple concepts



Creative Thinking Example

Concept #3

Vegetable Picking Device = Option 3

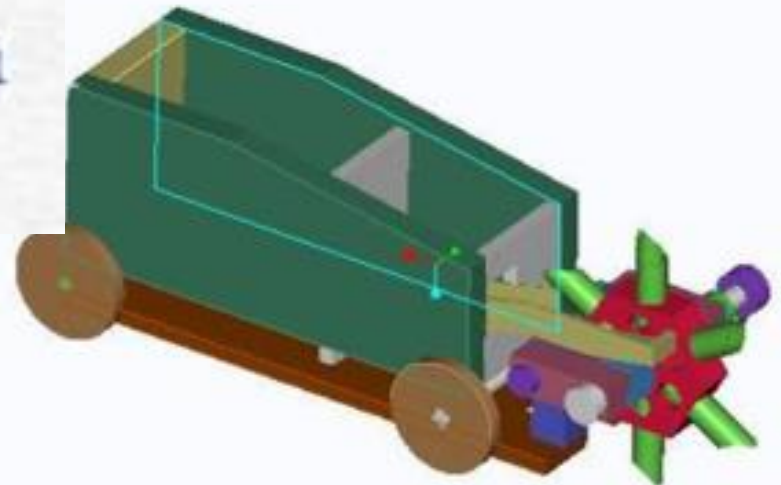
Vegetable Placing Device = Option 4

Dirt Sifting Device = Option 3

Packaging Device = Option 4

Method of Transportation = Option 1

Power Source = Option 2



Creative Thinking Example

Concept #4

Vegetable Picking Device = Option 2

Vegetable Placing Device = Option 4

Dirt Sifting Device = Option 3

Packaging Device = Option 1

Method of Transportation = Option 1

Power Source = Option 2

Note: Not all options need to be employed

