

Concept Generation

MAE 2250

Phases

- Phase 0: Planning
- Phase 1: Conceptual design
- Phase 2: System design
- Phase 3: Detail design
- Phase 4: Testing and refinement
- Phase 5: Production ramp-up



Iterate

Needs drive concept generation



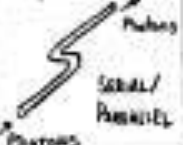

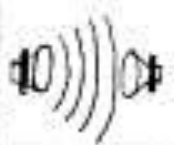



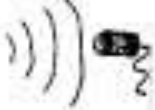






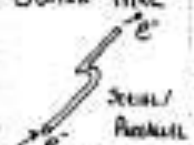
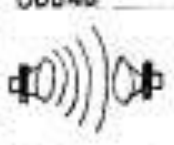

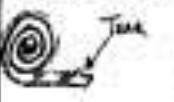

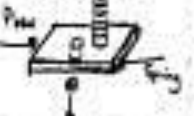
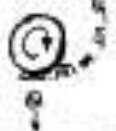





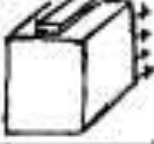

- Identify needs
- Establish target specifications
- Generate concepts
- Select concept(s)
- Test concepts
- Refine specs
- Plan project (downstream activities)

Concept generation

- Understand the problem and decompose into subproblems. Identify critical subproblems. Decomposition by sequence of user actions, or key needs.
- In parallel search for ideas old and new as follows:
 - New concepts: Search internally: Individual, group (brainstorming)
 - Existing concepts (externally): Users, experts, patents, literature, benchmarking
- Explore systematically: classify and combine many subsolution permutations.
- Reflect on integrated solutions; identify weak subfunctions where more ideas are needed.

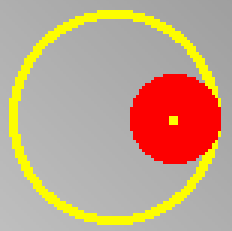
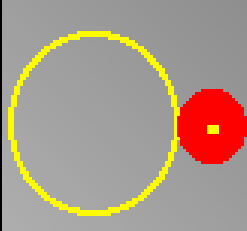
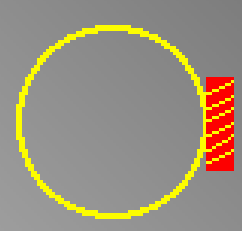
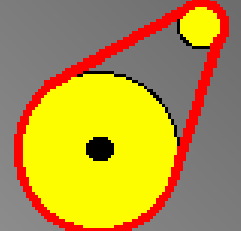
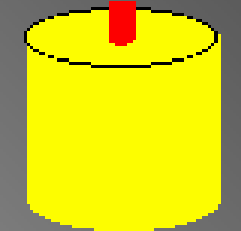
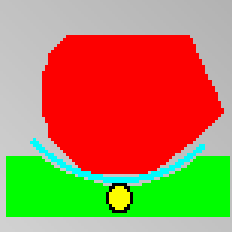
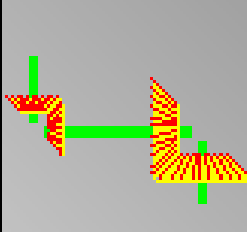
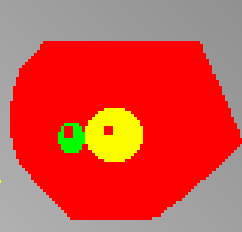
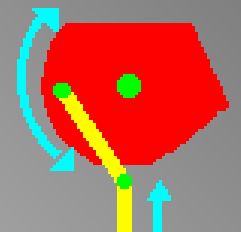

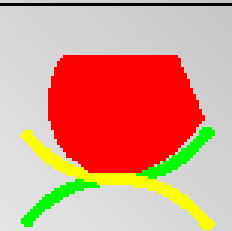
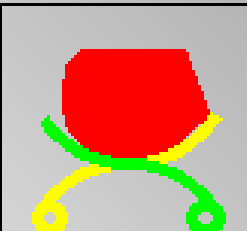
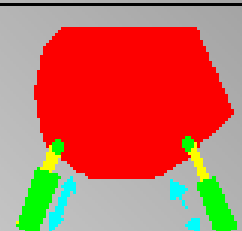
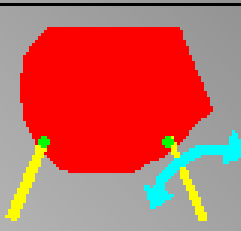
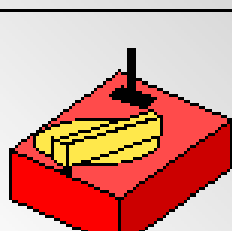
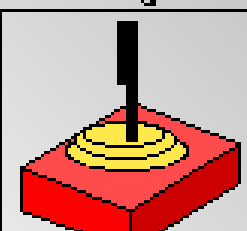

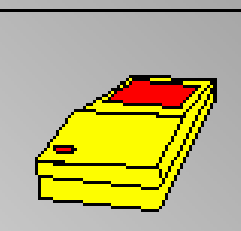
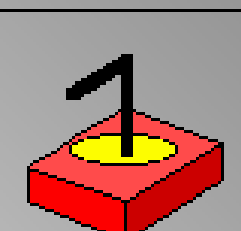
Morphological Chart

- Records concepts for subproblems
- Potential 'partial solutions'.
- Often recorded graphically with short description.
- Combinations and permutation of subsolutions span exponential number of product variations

BLOOD TESTING	AVOUCET DEVICE 							
TEST CELL TO COMPUTER	 SERIAL/ PARALLEL	FIBER OPTIC  SERIAL/ PARALLEL PHOTONS	COPPER WIRE  SERIAL/ PARALLEL e-	SOUND 	MECHANICAL 			
I.D.	MAGNET 	KEYBOARD 	VOICE 	RETINAL 	FINGERPRINT 	RADIO WAVES  TRANSMITTER SCANNER	FIELD SCANNER 	
COMPUTER TO DISPENSER	 SERIAL/ PARALLEL	FIBER OPTIC  SERIAL/ PARALLEL PHOTONS	COPPER WIRE  SERIAL/ PARALLEL e-	SOUND 	MECHANICAL 			
DISPENSER DEVICE	TICKET DISPENSE 	"GUMBALL" 	PUSH/PULL 	CRANE/POUCH 	"ATM" 	"GUN" 	"PRINTER/CUTTER" 	ROTATING BELT 
COMPARTMENT FITTING	RAILS 	"I" BEAM 	ROUND CUTS 					

Function

Pan

				
Internal Ring	External Ring	Worm	Belt	Direct Drive
				
Cradle	Bevel	Generic	Plunger	Belt
				
Belt Joint	Sliding Belt	Stewart	Four Bar	
				
Knob	Joystick	Trackball	Mouse	Handle

Tilt

Interface

Brainstorming

- **Judicial judgment of ideas is not allowed** - Criticism of ideas produced **MUST** be withheld until later. (Someone, or another group, will evaluate the ideas later.)
- **'Free-Wheeling' is welcomed** - The wilder the idea, the better. It is easier to moderate than to produce.
- **Quantity of ideas is wanted** - The greater the number of ideas, the more likelihood of good ones.
- **Combination and improvement are sought** - In addition to contributing their own ideas, each member suggests how ideas contributed by others can be improved, or how two or more ideas could, with advantage, be combined.

Nail Gun

1. Convert electrical energy to translational energy
2. Accumulate energy
3. Transfer energy to nail



**Convert
Electrical Energy to
Translational Energy**

Rotary motor with
transmission

Linear motor

Solenoid

Rail gun

**Accumulate
Energy**

Spring

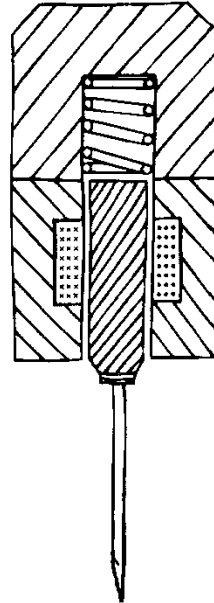
Moving mass

**Apply
Translational
Energy to Nail**

Single impact

Multiple impacts

Push nail



**Convert
Electrical Energy to
Translational Energy**

Rotary motor with
transmission

Linear motor

Solenoid

Rail gun

**Accumulate
Energy**

Spring

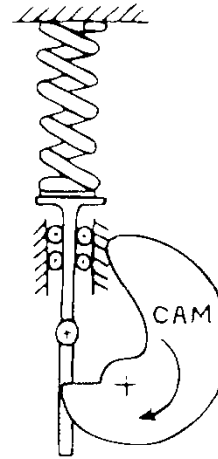
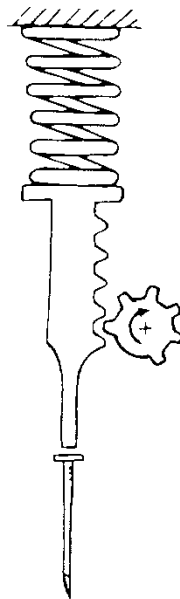
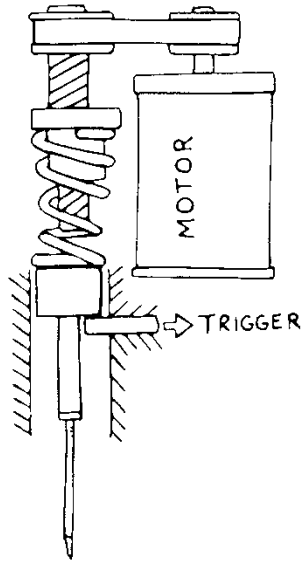
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**Convert
Electrical Energy to
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Rotary motor with
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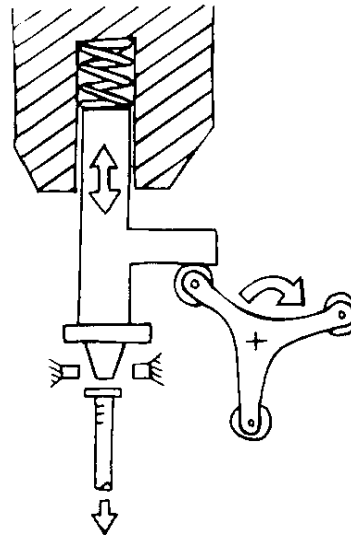
Spring

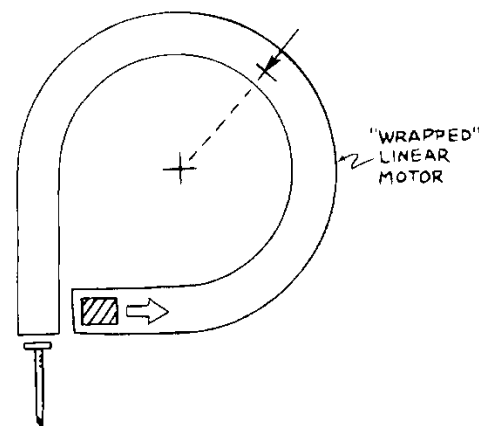
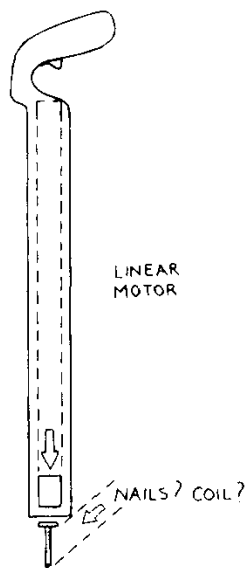
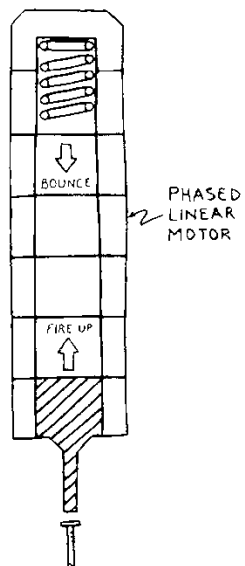
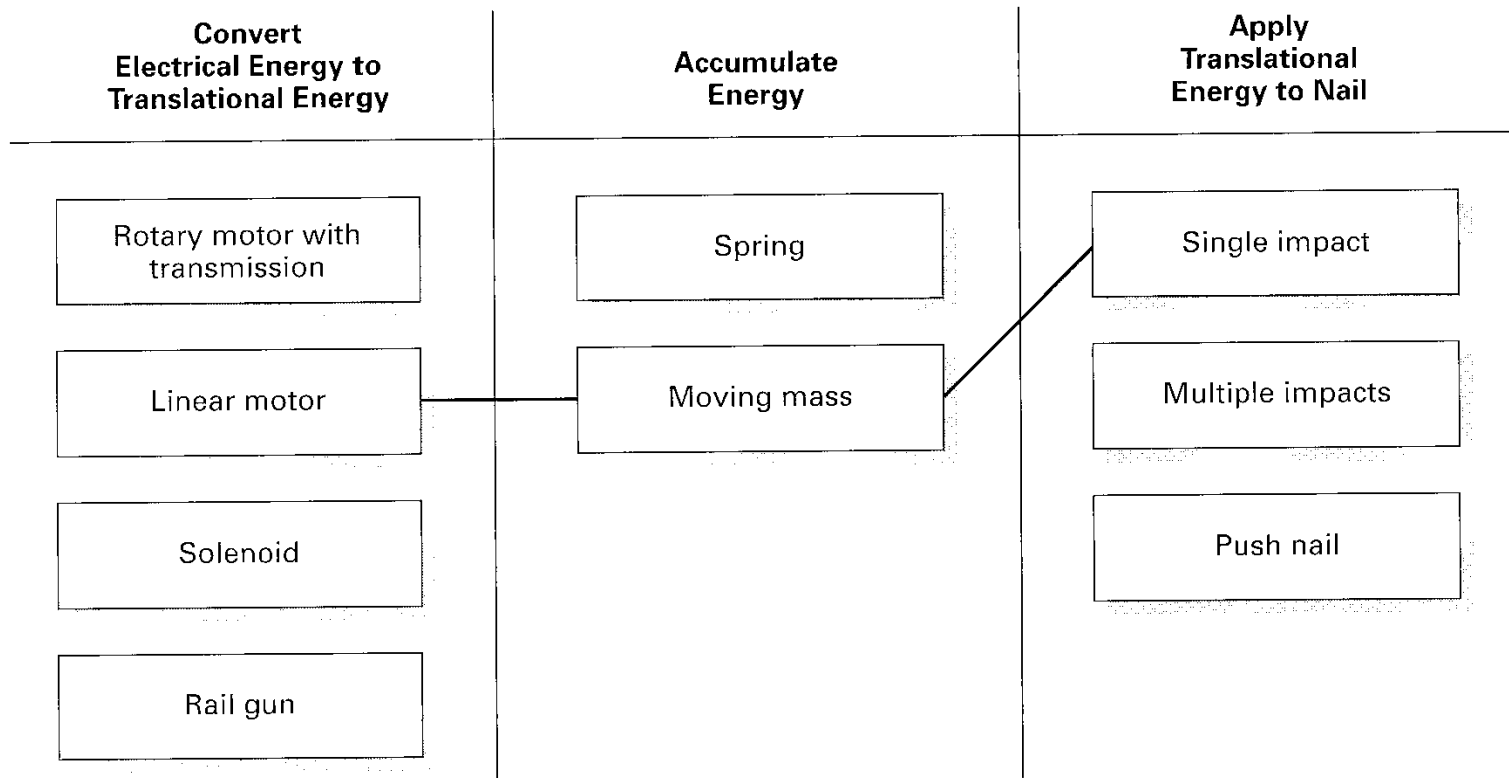
Moving mass

Single impact

Multiple impacts

Push nail





Tips for coming up with ideas

- Make analogies through different scales, different domains,
- Suspend judgment; welcome ideas that are infeasible
- Use graphical media
- Use stimuli from partially related products
- Set target number of concepts: “at least 20 concepts”
- Use gallery method: Pin ideas on boards
- Wish and wonder “I wonder what would happen if...”
- Use established methods: TRIZ
 - Proposes solutions for common conflicts
 - E.g. Weight conflicts with force. Suggested solution: Periodic motion

"I don't think you can design anything just by absorbing information and then hoping to synthesize it into a solution. What you need to know about the problem only becomes apparent as you're trying to solve it."

-- Richard McCormac