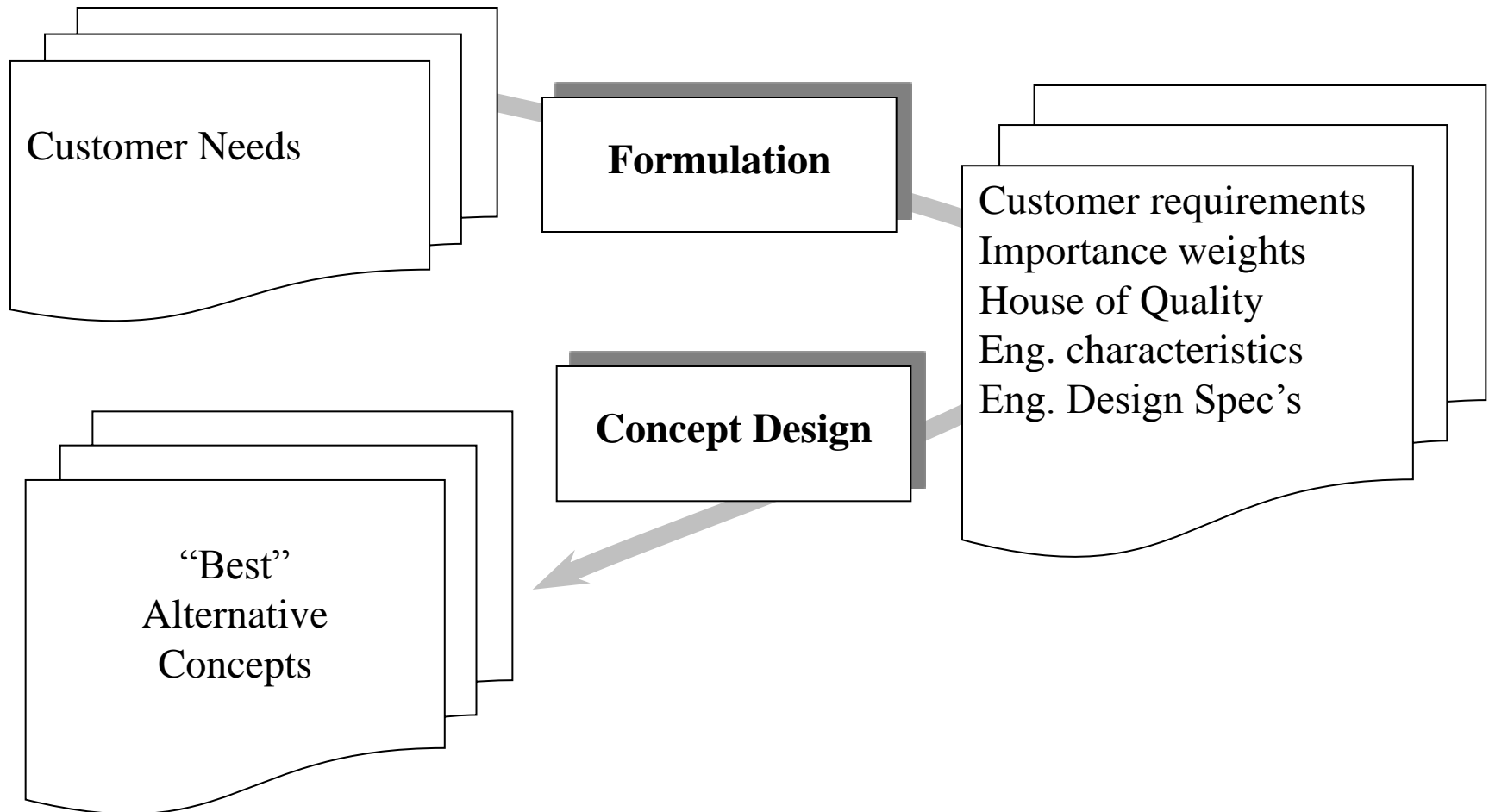




Concept Design (Part A)

- What is a design concept?
- Clarifying functional requirements
- Generating design concepts
- Analyzing alternatives

Inputs & outputs of Formulation and Concept Design phases





What is an alternative concept design?

For slowing and stopping a spinning shaft?

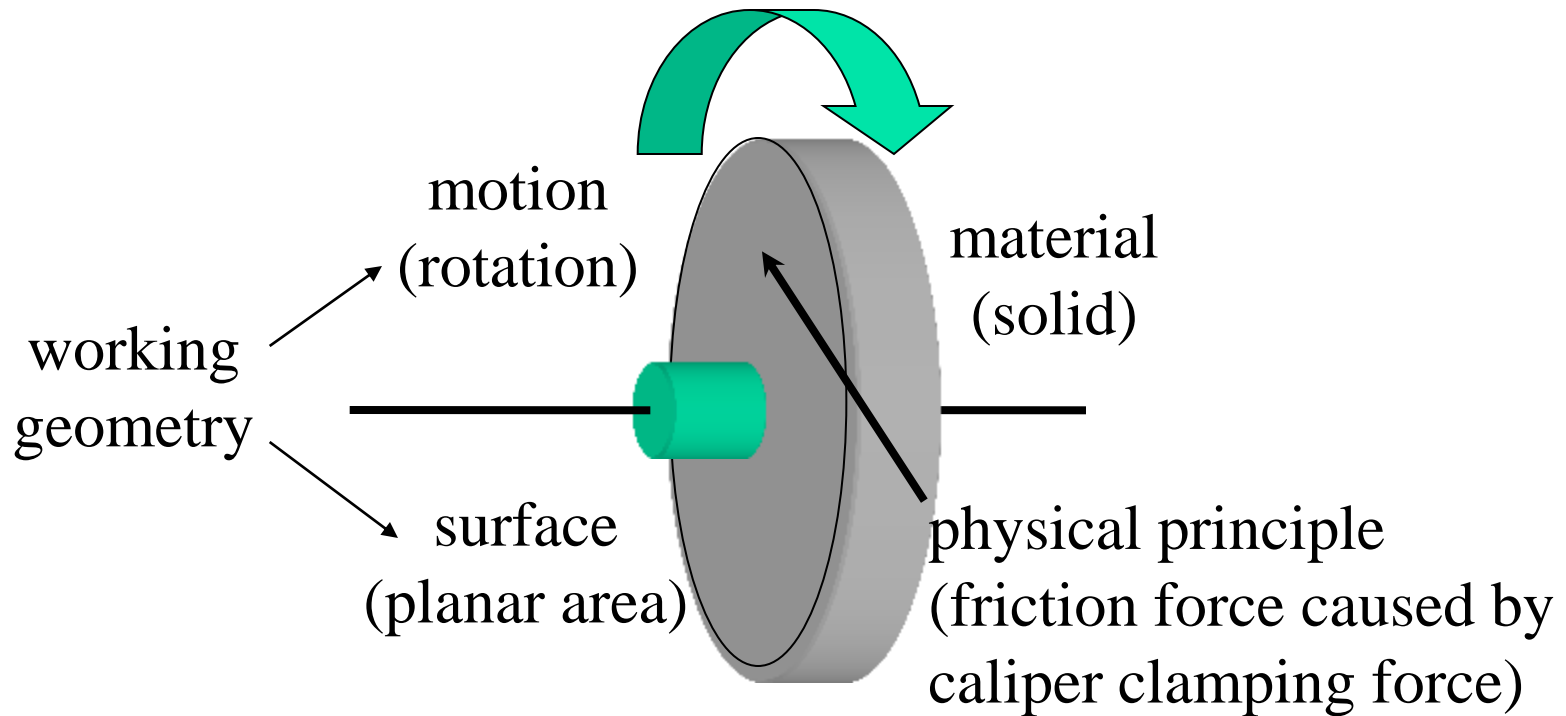
<u>Alternative</u>	<u>Physical principle</u>	<u>Abstract Embodiment</u>
1	fluid friction	fan blade on shaft
2	magnetic field	re-generative brake
3	surface friction	disk and caliper brake

For fastening sheets of paper?

<u>Alternative</u>	<u>Physical principle</u>	<u>Abstract Embodiment</u>
1	spring force - elastic	paperclip
2	bent clamp - plastic def.	staple
3	bendable clamp - plastic	cotter pin
4	adhesion- chemical force	glue

"Working principle" of a disc brake

(Pahl & Beitz, European community)



Note: no sizes, only vague shape



Design concept

Definition:

abstract embodiment of:
physical principle,
material, and
geometry.

Purposefully vague

Surfaces, motion



How do we proceed?

- Need lots of feasible design concepts (i.e. alternatives)
- Need to select the “best” one or two concepts
- Is there a process that we can follow?
- Can we use the overall Design Process to guide us through the Concept Design phase?



Customer activities

Examine interaction between customer and product

Use

set up
operate
maintain
repair

Retire

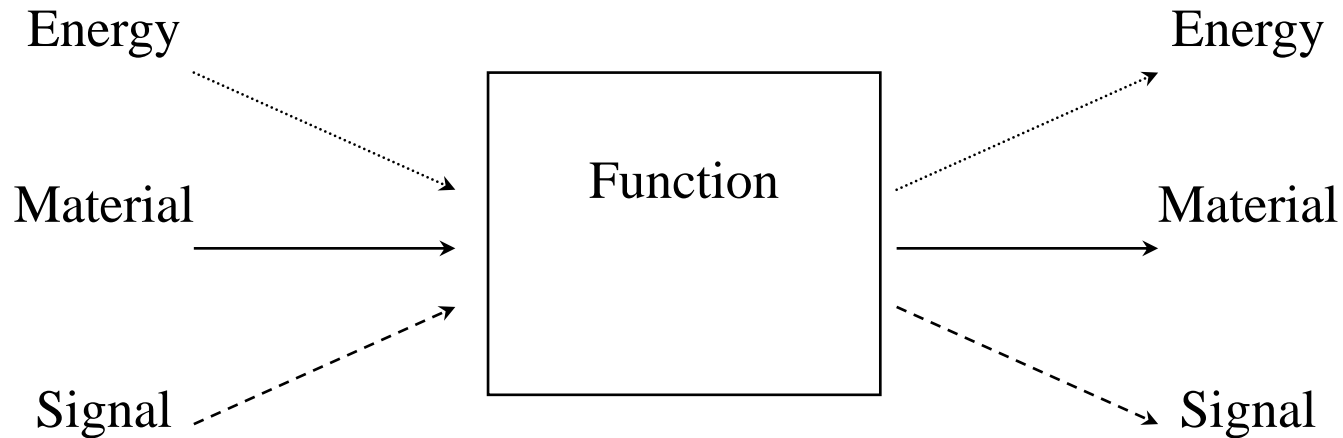
take down
disassemble
recycle
dispose



Function structure diagrams shows all inputs and outputs

State 1

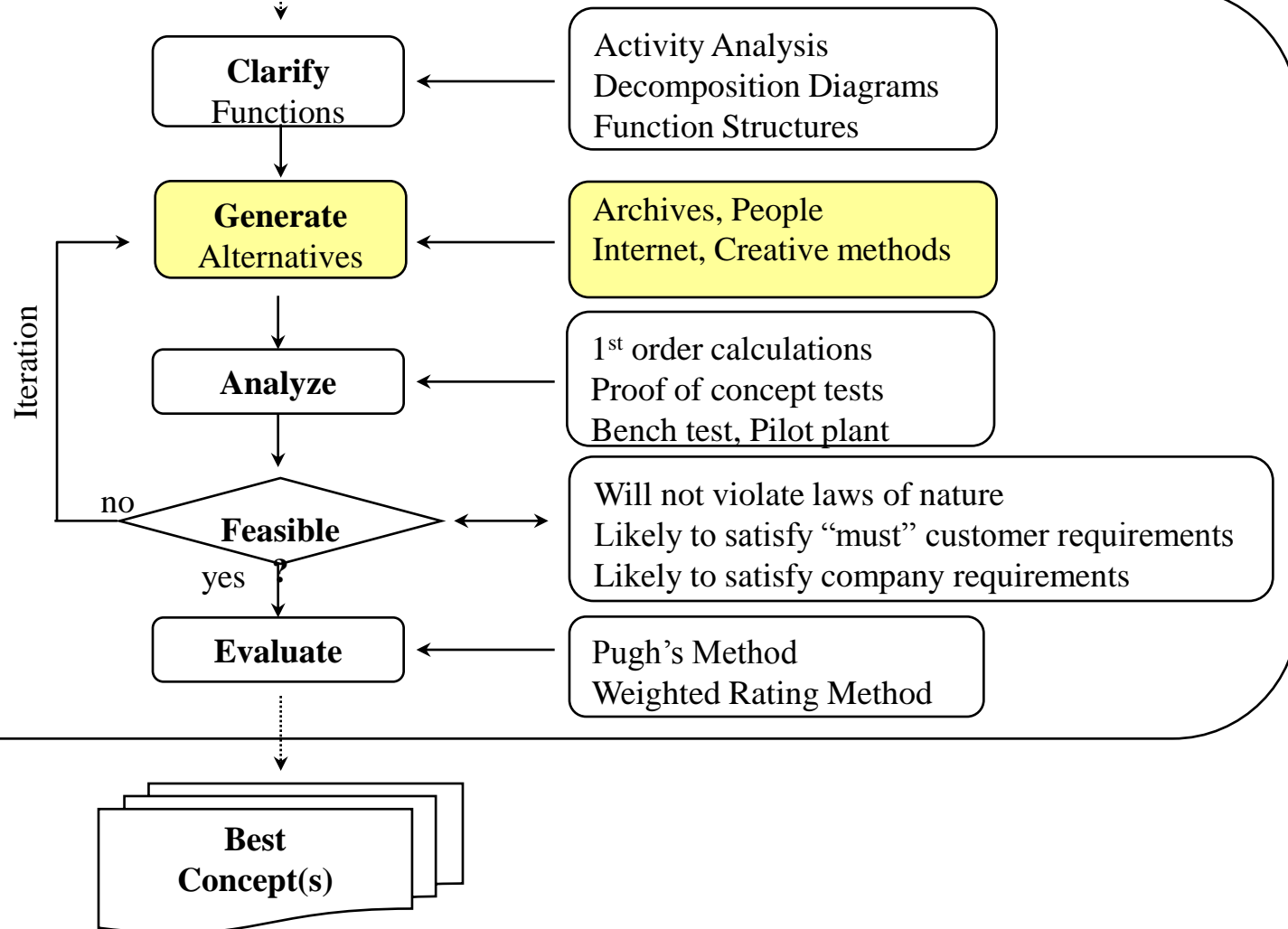
State 2



How do we do generate alternative concept designs?

Engineering Design Specification

Concept Design





Generating alternatives – find or create

Archives

libraries (university, public, corporate)

literature (handbooks, monographs, trade mag.s, journals, encyclop.)

People - coworkers, faculty, vendors, consultants

Internet - US Patent office, vendors, professional societies, etc

Existing products – similar or competitive products
(benchmarks), dissection, reverse engineering

Creative methods

Brainstorming

Method 635

Synectics (analogies, fantasy, empathy, inversion)

Checklists (Osborn: substitute, combine, adapt, magnify, put to other use, eliminate, rearrange, and reverse).



“Developing” generated concepts

E.g. mini bike

		Alternative Concepts		
		1	2	3
functions	Transmit	Chain	Belt	Gearbox
	Brake	Disc	Drum	
	Steer	Handlebar	Control stick	Fly-by- wire



Analyzing = “predicting” and “screening”)

(Roughly) predict / estimate how each alternative might perform.

1. 1st order calcs. (back of the envelope)
2. Proof of concepts (physical principle “tests”)
3. Bench top/pilot plant (subassembly/system tests)

Screen infeasible alternatives (screening criteria include)

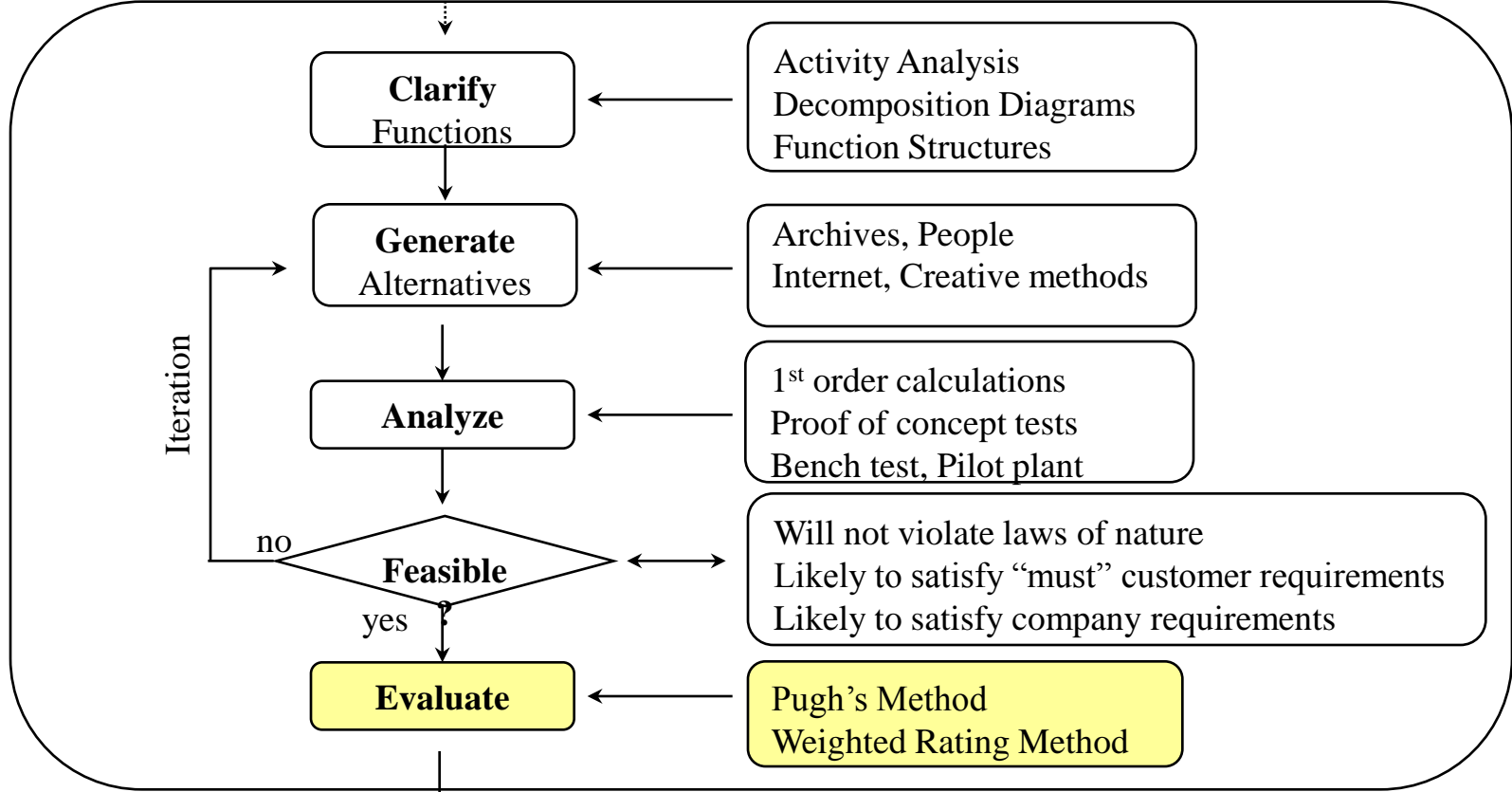
1. likely function (i.e. not violate laws of nature)?
2. likely satisfy other customer requirements?
3. likely satisfy important company requirements?

Next step?

**Engineering
Design
Specification**

Evaluating

Concept Design



**Best
Concept(s)**



Summary

- Clarify functional requirements
 - Activity analysis method
 - Function decomposition diagram method
 - Function/structure diagram method
- Generate alternatives (by finding/creating)
 - Finding
 - Archives, People, Internet, Existing Products
 - Creative methods
 - Brainstorming, Method 635, Synectics, Checklists
- Analyze – likely to work, be manufacture-able



Concept Design: Analysis & Evaluation (Part B)

- Developing concept combinations
- Analyzing alternative designs
- Evaluating “ ”
- Information flow & storage
- Intellectual property protection

What does it mean to “evaluate” feasible concept designs?

feasible concept designs

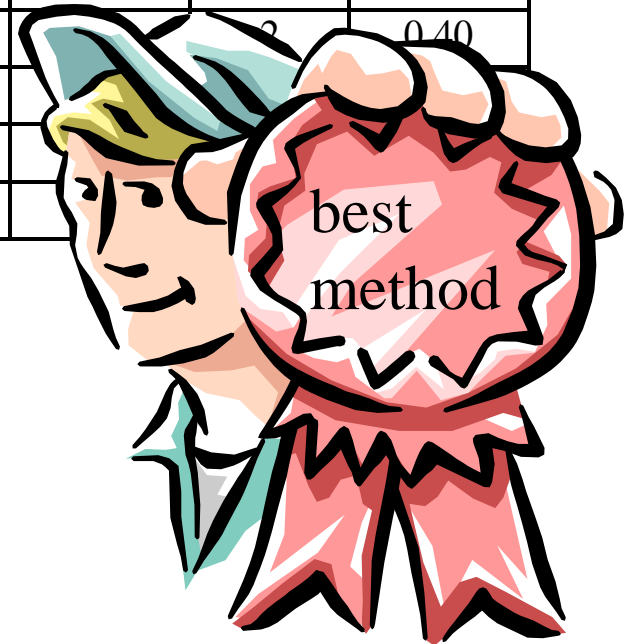


However: e-“valu”-ate = values? whose?

Weighted Rating evaluation method

		Concept Alternatives					
		gears		v-belts		chain	
Criteria	Importance Weight (%)	Rating	Weighted Rating	Rating	Weighted Rating	Rating	Weighted Rating
high efficiency	30	4	1.20	2	0.60	3	0.90
high reliability	25	4	1.00	3	0.75	3	0.75
low maintenance	20	4	0.80	3	0.60	2	0.40
low cost	15	2	0.30	4	0.60	4	0.60
light weight	10	2	0.20	4	0.40	4	0.40
	100	NA	3.50	NA	3.50	NA	3.50

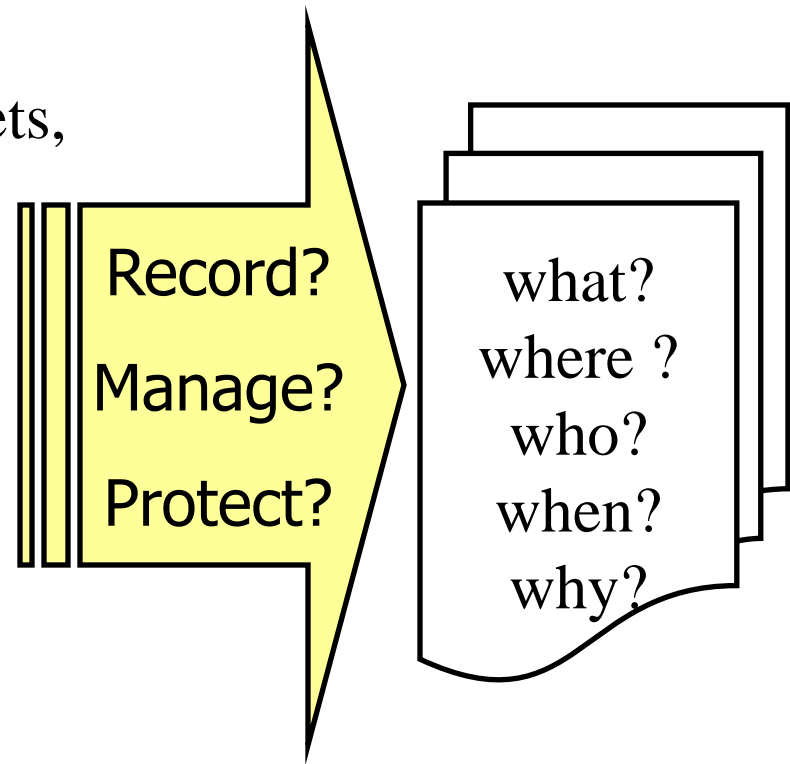
Rating	Value
Unsatisfactory	0
Just tolerable	1
Adequate	2
Good	3
Very Good	4





Information flow & storage

- photocopies of archival matter,
- printouts from the Internet,
- vendor catalogs and data sheets,
- preliminary test results,
- first-order calculations,
- patent abstracts,
- minutes of meetings,
- concept sketches,
- concept screening sheets
- concept evaluation matrices
- expert interview notes





Design information protection

Is design “information” property?
Whose property is it?
Can it be protected?



Types of Property

Real property – land, buildings

Personal property

Tangible – trucks, machines, office equip.

Intangible -

contracts

copyrights

trademarks

patents

trade secrets

How can we protect each type of property?



Contracts

Def.:

Written/oral agreement between two parties.

Examples:

Non-disclosure, confidentiality agreements



Copyrights

Def.:

Exclusive right to the publication, production, or sale of the rights to a literary, dramatic, musical, or artistic work.

Examples:

book, sheet music, software, dramas, sermons



Trademarks

Def.:

A symbol, design, word, or letter used by a manufacturer or dealer to distinguish his products from those of his competitors.

Examples:

IBM, GE, XEROX, COKE, Pentium



Trade Dress

Trade Dress is a distinctive, nonfunctional feature, which distinguishes a merchant's or manufacturer's goods or services from those of another. (appearance)

The trade dress of a product involves the "total image" and can include the color of the packaging, the configuration of goods, etc... Even the theme of a restaurant may be considered trade dress.

Examples include the packaging for Wonder Bread, the tray configuration for Healthy Choice frozen dinners, and the color scheme of Subway sub shops.

(http://www.amerilawyer.com/trademark/tm_tradedress.htm)

Trade Dress Examples





Patents

Def.:

A document granting monopoly rights to produce, use, sell or get profit from an invention, process, plant(biological) or design.

Examples:

Utility patent - Xerox copying, Canon Laser engine, household appliances, light bulbs, cameras.

Process patent - polymers such as Lexan, Rayon, Delrin

Design patent - ornamental aspects of a product such as shape, configuration, and/or any surface decoration.



Trade Secret

Def.:

A method used to make a product, that is kept secret by the company manufacturing the product.

Examples: Coca-Cola, Coors beer, other food recipes



Protection Summary

	Protects	Length	Application Required	Registration Available	Costs
Trade Secret	formulas, recipes, processes	indefinite	no	no	some
Contract	items specified	length of contract	no	no	>\$500
Trademark	graphical symbol or word	20 yrs renewable	no	yes	>\$350
Copyright	literary, musical or artistic works	author's life+70 yrs	no	yes	>\$30
Utility Patent	function, process	20 yrs	yes	yes	>\$1,100
Design Patent	appearance	14 yrs	yes	yes	>\$500



How will you protect your company's intellectual property?

- Contract
- Copyright
- Trademark
- Patent
- Trade secret



Summary

- Concept Designs need review
- Analyzing - predicting
- Developing “product” alternatives
- Evaluating - weighing satisfaction
- Information flows & requires storage
- Intellectual property needs protection