INDUSTRIAL DESIGN METHODS

Peihao Li

"This handbook should not be used dogmatically, rather, it should inspire the designer to develop new approaches to problem solving."

Professor Walter Schaer, PhD. 1977

Industrial design is a creative activity that aims to build a multifaceted quality of goods, processes, services, and the systems they make throughout their life cycle.

Industrial design is a specialized service that optimizes the shape, function and use value of the product and product range for the benefit of both the user and the producer.

This book contains detailed methods and diagrams for industrial design. I believe this book will make you feel the joy of design.

Peihao Li fall 2019

INDUSTRIAL DESIGN METHODS HANDBOOK
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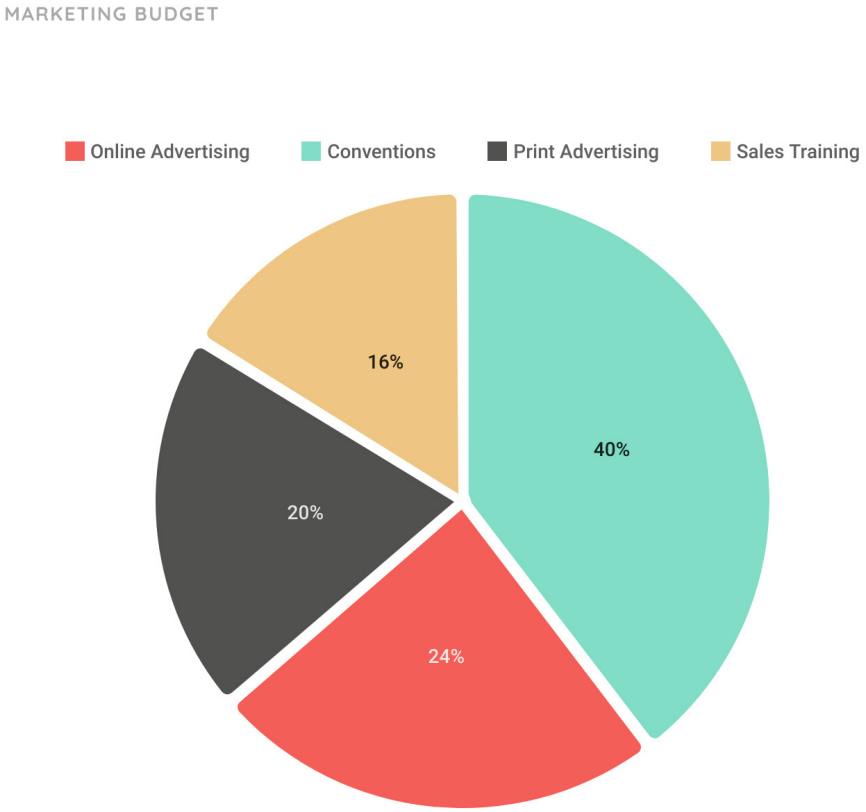
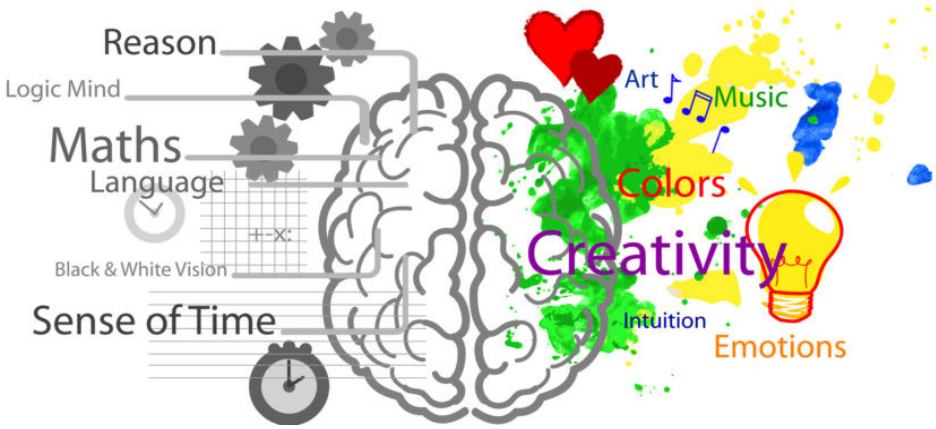
2.1 Statement PIE

Firstly, what is PIE and Theory of Signs? The "P" is proof, the "I" is information, the "E" is example. How about the Signs? A sign is something that stands for something. A sign is communication. If your design does not communicate then its not a good solution. If there is no sign then the designer has failed. A designed object or system needs to express purpose.

2.1 Statement PIE





2.2 Interviews of Professionals

Interviewer: Peihao Li
Discipline: Architecture
Professor: Randy
Interviewee: James
2019.9.10

The interviewees said that their identity is a problem solver. For example, the data is out of order or is complained by the user. Although each designer has his own way of solving the problem. But not everyone is solving the problem in the most elegant way. The interviewees said that whenever they encounter problems, they usually start with "why." Because the user is always describing "what". “what” is the specific manifestation of the problem. They will first observe the data. The provider of the data is a novice or a manager with certain qualifications.

Try to find valuable information within a limited resource. Then start searching for the "why" process. Need to search for more data, see the nature of the problem through the phenomenon, so there is an elegant way to solve the problem.

2.2 Interviews of Professionals

Interviewer: Peihao Li
Discipline: Mechanical engineering
Professor: Randy
Interviewee: Ryan
2019.9.10

According to the interviewees, there are many problems faced by mechanical engineers. Even in the same position, there are many differences in the problems faced. They don't need to "can solve almost any problem." What they have to do is to accurately analyze the "root cause" of the problem, and then to figure out who needs to solve this problem and how to solve it.

The chief engineer needs to be responsible for the overall project (product), know which standards the product needs to meet, follow up the standard update in time, understand the customer's needs and their own requirements for the supplier, and understand the advantages and disadvantages of their products and competitors' products. . Improve and improve products based on the goals set by the supervisor.

2.2 Interviews of Professionals

Interviewer: Peihao Li
Discipline: computer science
Professor: Randy
Interviewee: Logan
2019.9.10

The interviewee said that computer thinking is the method of thinking and the way of doing things that are experienced and acquired in the process of learning and applying the theory and skills of computer science. At the macro level, including the understanding of the idea of "computable", that is, how to use the computer tool to turn the method of dealing with problems in the virtual world into a solution to various practical problems in real life. In other words, computer thinking requires you to find a computer solution strategy for real-life problems.

At the micro level, all kinds of resources inside and outside the computer must be reasonably numbered and stored, and then accessed according to the number. There must be a reasonable numbering scheme and a high-efficiency access algorithm with it. This is the key to realizing the various applications of the computer. In life, it is equivalent to the rationality of our dealings with various things.

2.2.1 Summary Chart of Interviews

problem solving processes

	design	creative	technology
Computer science	development formation	understanding the solution	observation
Mechanical engineering	research information	searching for methods	hypothesis
Architecture	presentation communication	definition asking questions	theory

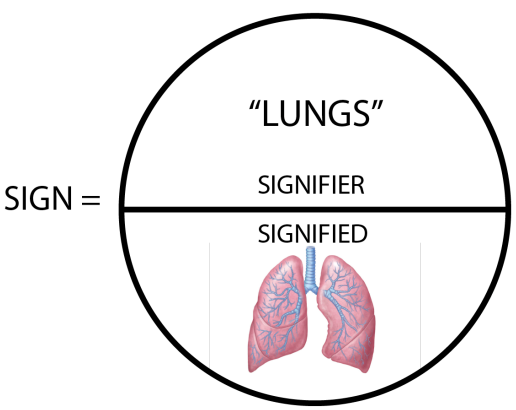
2.3 Theory of Signs

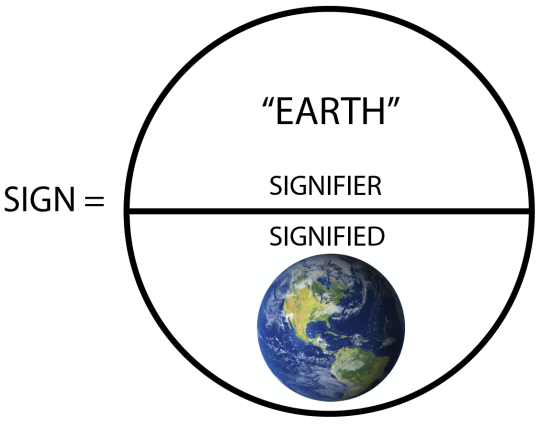
Theory of Signs

When you see the world you see material things. There exist a SIGN for everything. People look at objects as a sign.
A sign is abstract. The sign must have a vehicle or it doesn't exist. Any sign (product or system) can be broken down into three dimensions.

SEMIOTICS

Semiotics is the study of meaning-making, the study of sign process (semiosis) and meaningful communication.





SYMBOL

ICON

Breathing
Life
Oxygen

INDEX

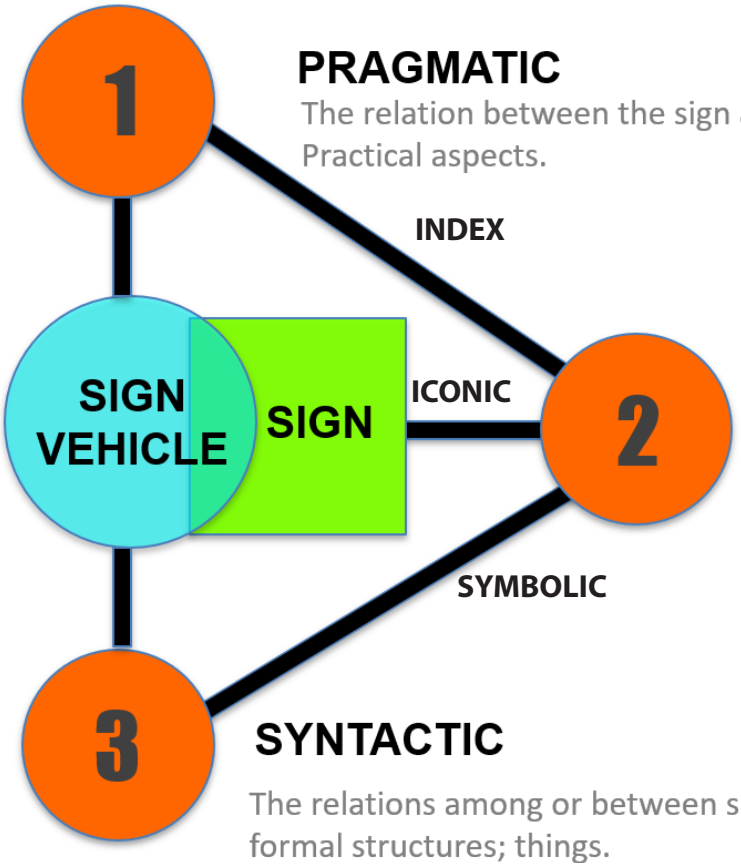
SYMBOL

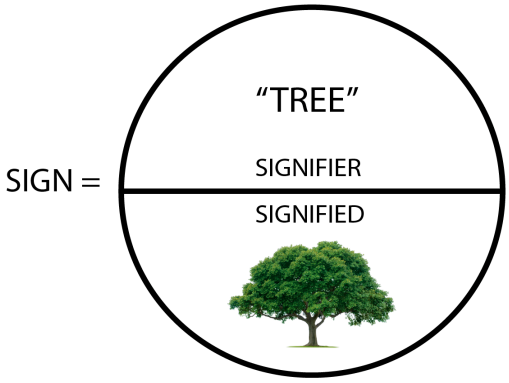
ICON

Life
Nature
Environment

INDEX

2.3 Theory of Signs





SYMBOL ICON

Nature
Forest
Deforestation
Earths Lungs

INDEX

2.4 Problem Solving Processes

INDUSTRIAL DESIGN A General Definition:

Industrial design is concerned with the design and planning of Aesthetics and Human Factors in man-made facilities and equipment. Industrial designers work in cooperation with marketers and engineers who are responsible for the promotional delivery and technical factors of a product or system.

Since industrial design lies in the human aspects and technical aesthetics of products and systems there is a focus on how people need to live, and consequently in the development of concepts, which will enhance the quality of life.

Industrial design is concerned primarily with the aesthetic and practical relation of artifacts to those who use them in the context of humanizing technology.

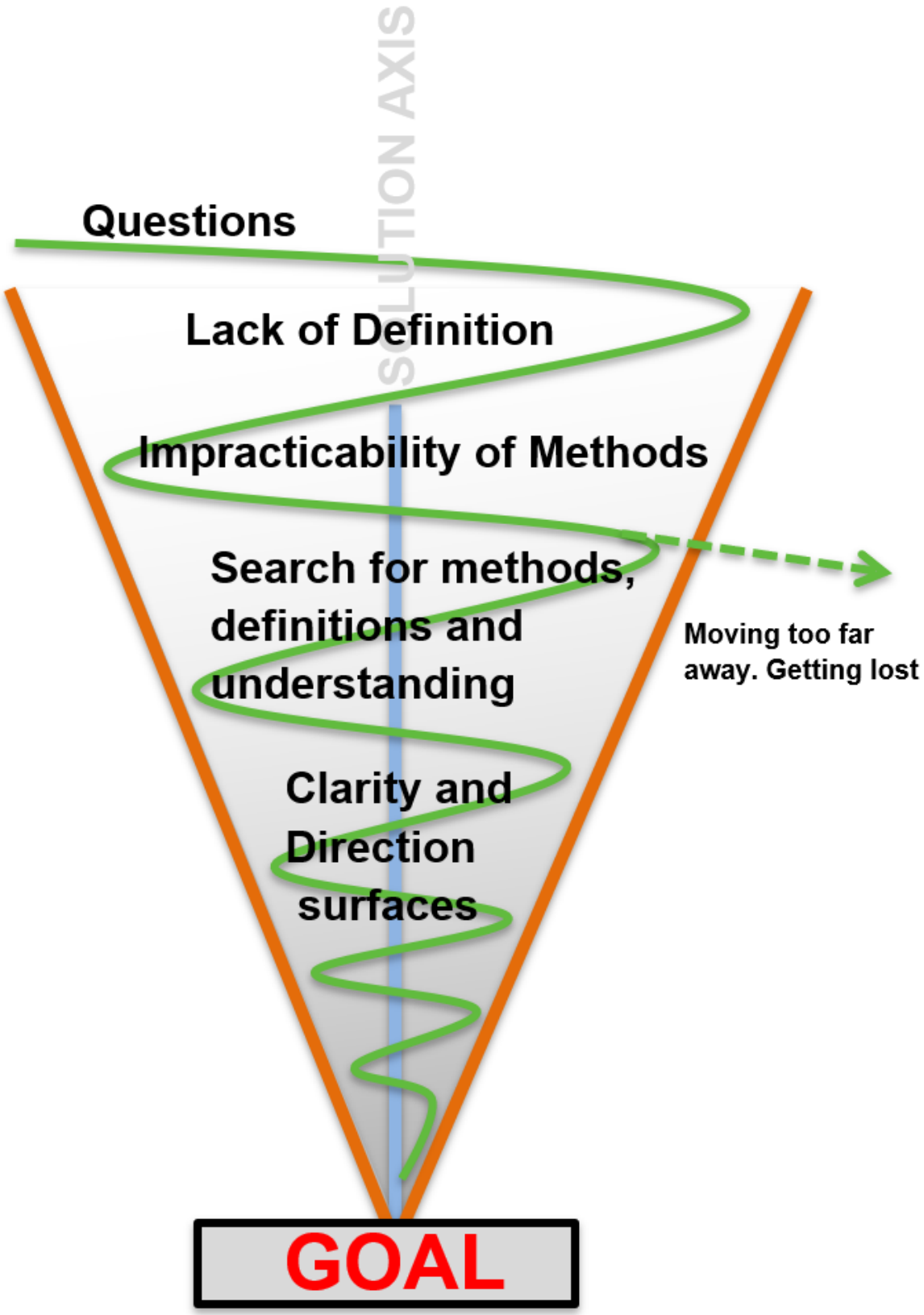
2.4 Problem Solving Processes

Designed to guide innovation, promote business success, and provide a better quality of life, (Industrial) is a design activity that applies strategic problem-solving processes to products, systems, services, and experiences. It is an interdisciplinary profession that connects innovation, technology, business, research, and consumers to create creative activities, visualize problems that need to be addressed, and propose solutions that re-deconstruct problems. It provides new value and competitive advantage as an opportunity to build better products, systems, services, experiences or business networks. (Industrial) design is to create a better world through the response of its output to social, economic, environmental and ethical issues.

2.4.1 Creative Process

In industrial design, no matter what method is adopted, we will always come down to finding and solving problems. The "problem" is the starting point and the end point of the design. The design process is the process of solving the problem. The paper will solve the problem from the perspective of solving the problem. On the basis of expounding the problems of real and potential problems, functional problems and non-functional problems, the paper points out the ways to find problems in industrial design, and then classifies, decomposes, integrates and transforms the problems. The aspect proposes a solution to the problem.

2.4.1 Creative Process



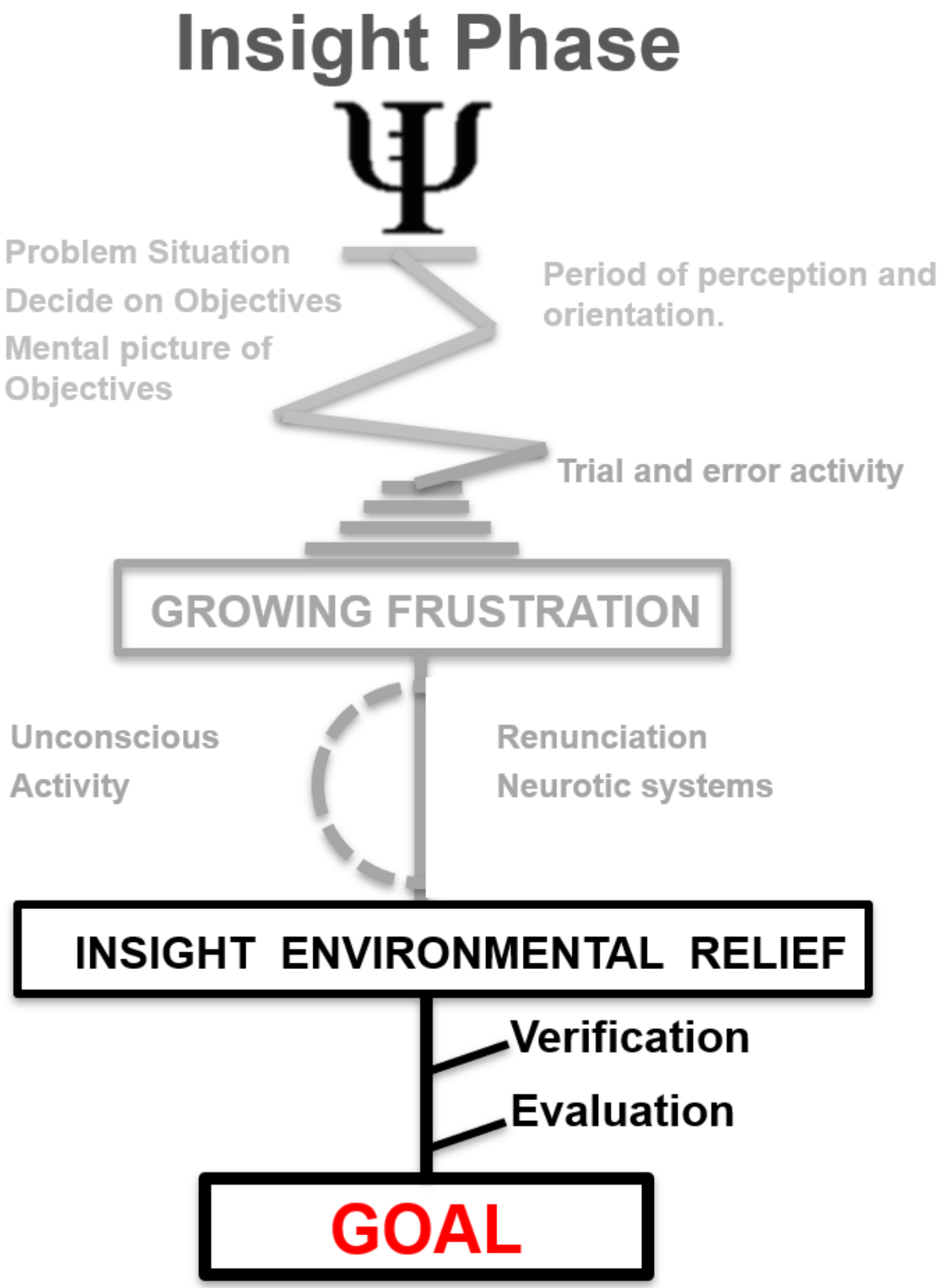
2.4.2 Psychological Process

Preparation Phase. In the preparation phase we must understand and evaluate the problem situation. Good motivation is very important in the preparation phase.

Three basic steps in the preparation phase.
1. State the problem situation in operational terms very clearly.
Must be understandable and useable.
2. Decide on objectives.
You must have an overall picture.
3. Realize and formulate a mental picture of the objectives.
You must have an overall picture.

The Preparation Phase is a Collection of Possibilities. This where your unconscious mind is working. The mind has to be loaded with possibilities. This is sometimes called the period of frustration. You should have an open mind. Get rid of old beliefs so you are able to receive new solutions.

2.4.2 Psychological Process



2.4.3 Methodical Process

Theory of Design

HUMAN FUNCTION TECHNICAL FUNCTION PRODUCTION FUNCTION

The Human Function is divided into Human Needs
Human Needs are divided into three sections

Economic - Social PRICE QUALITY The price paid and the social acceptance of the product or system

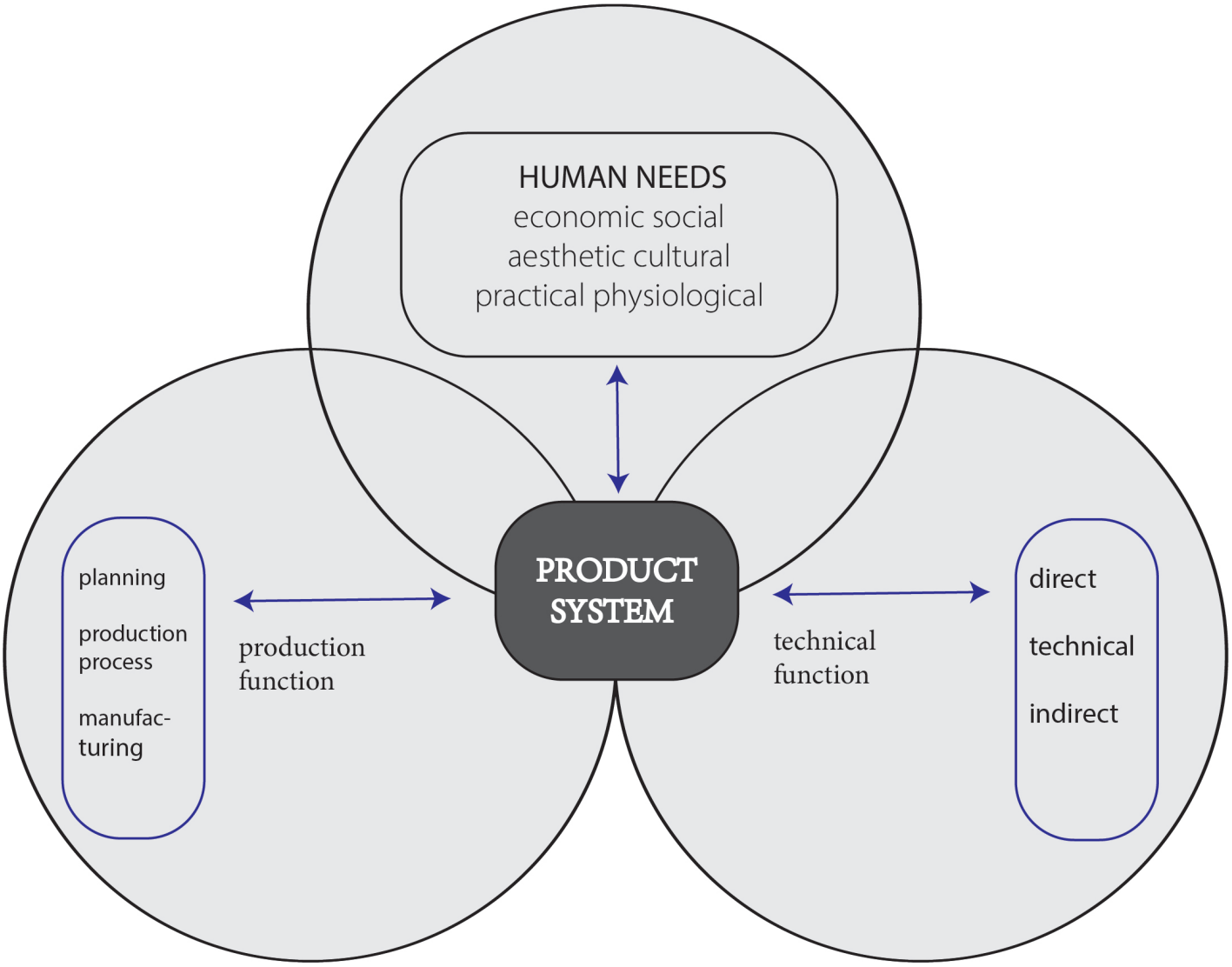
Aesthetic - Culture Form Quality The cultural and visual acceptance of a product or system.

Practical - Physiological Efficiency Quality The practical and physical efficiency and acceptance of a product or system.

Technical Process Direct Factors Factors that primarily effect the materials used in the design solution, but not limited to materials. Indirect Factors Factors effected indirectly by the components in the design solution. V

Production Process Manufacturing The production process of the components, parts and assembly.
Planning This deals with packaging, shipping, distribution, marketing, and sales.

2.4.3 Methodical Process



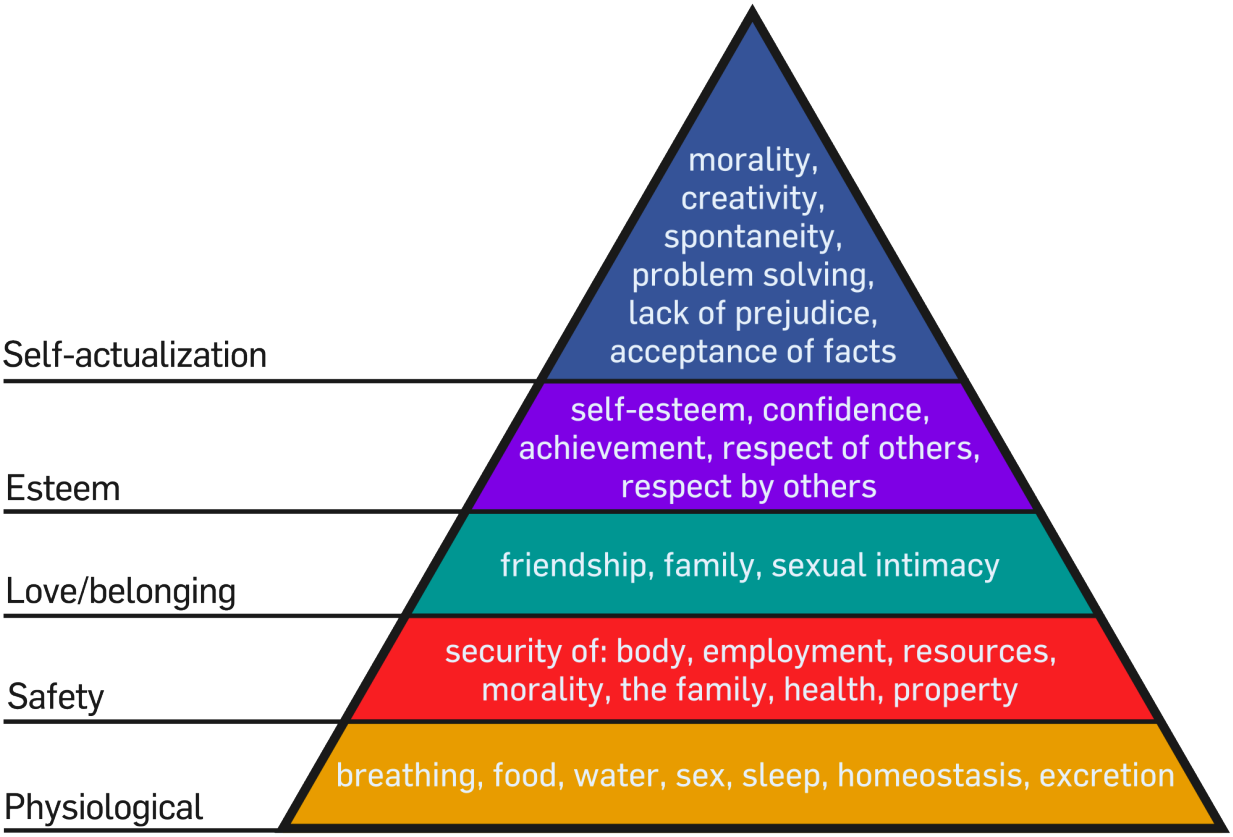
2.4.3 Methodical Process

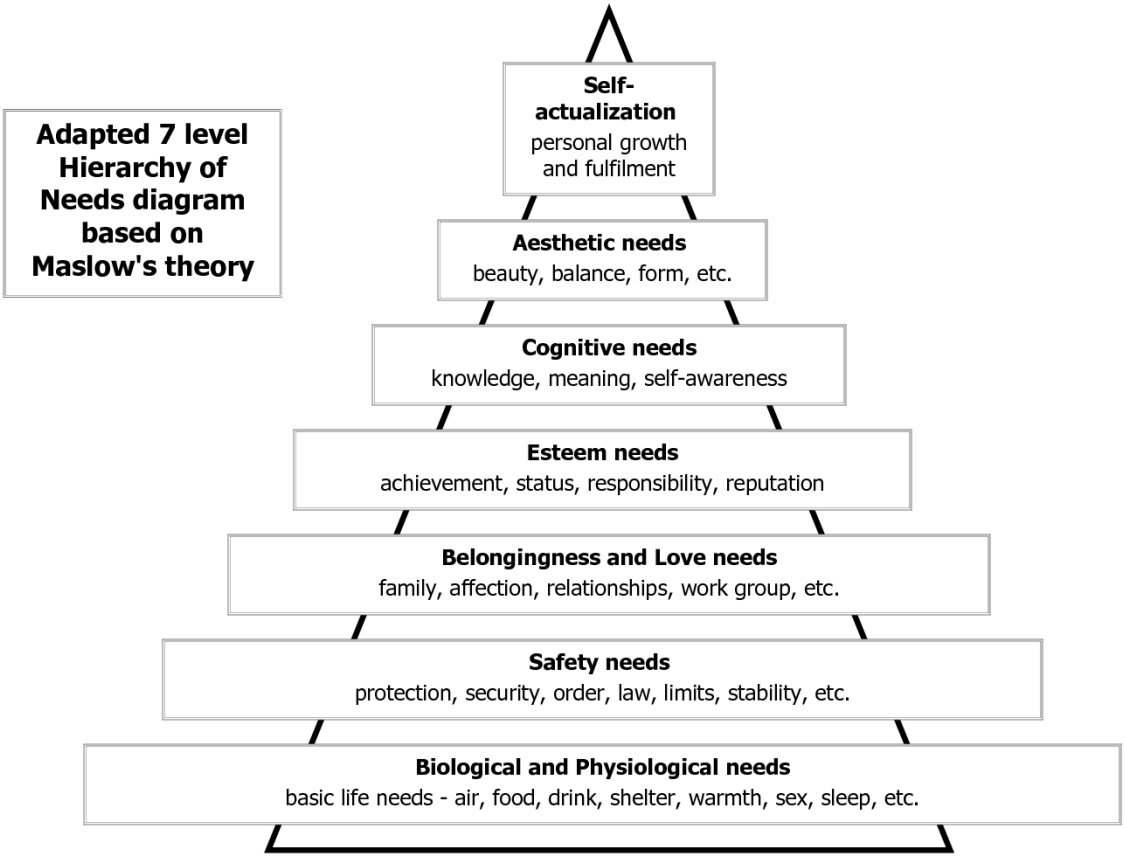
Maslow’s hierarchy of needs

What is rarely known is that Maslow, in 1970, changed his original model, developed in the 1950s, from 5 to 7 levels of need. He added 'Know and Understand' and 'Aesthetic'. This upgraded model was largely ignored, as the earlier model had become so deeply embedded in teacher and trainer training courses.

Anyone familiar with epistemology and aesthetics will immediately see the problem. Both are notoriously difficult to define.

2.4.3 Methodical Process





3.1 Design Process Checklist

The checklist is based on the Circular Design Process

The PROCESS
Phase and Steps
The Phases are:
Design Research
Design Development
Design Presentation or Communication
The Steps in the Circular Design Process

The ACTIVITY
Event to Event
This what you do during the design process.

The EVENT
This is the deliverable.
Includes size, quantity and other details

The TIME
The total hours it takes to complete the event.

The COST
Cost can be figured on 3 times the base salary.

The RESOURCE
Used to list notes, website address, and other information that pertains to the project.

3.1 Design Process Checklist

DESIGN PROCESS CHECKLIST

PROJECT TITLE	CLIENT	DATE:	DESIGN FRIM NAME	PROJECT NUMBER

PROCESS		ACTIVITY		EVENT		TIME	COST	RESOURCE
Phases	Steps	(from event to event)	NO.	(deliverables)	NO.	A + 4n + B / 6	3 x base salary 24/72	
DESIGN RESEARCH	1.1	Identify need of product and objectives	0- 1	Power Point presentation	1	4 hours	288	
		collect information	1 - 2	internet search	2	2 hours	144	
		train in use of the object	1 - 3	two days of training	3	7 hours	504	to be determined
	1.2	Develop Problem Statement	2 - 4	one page report	4	1 hour	72	
		define performance criteria	4 - 5	one page report	5	2 hours	144	meet with design staff
		2D sketches	3 -6	10 idea sketches - 8.5 x 11 paper - 3 line weight no marker	6	15 hours	1080	design team

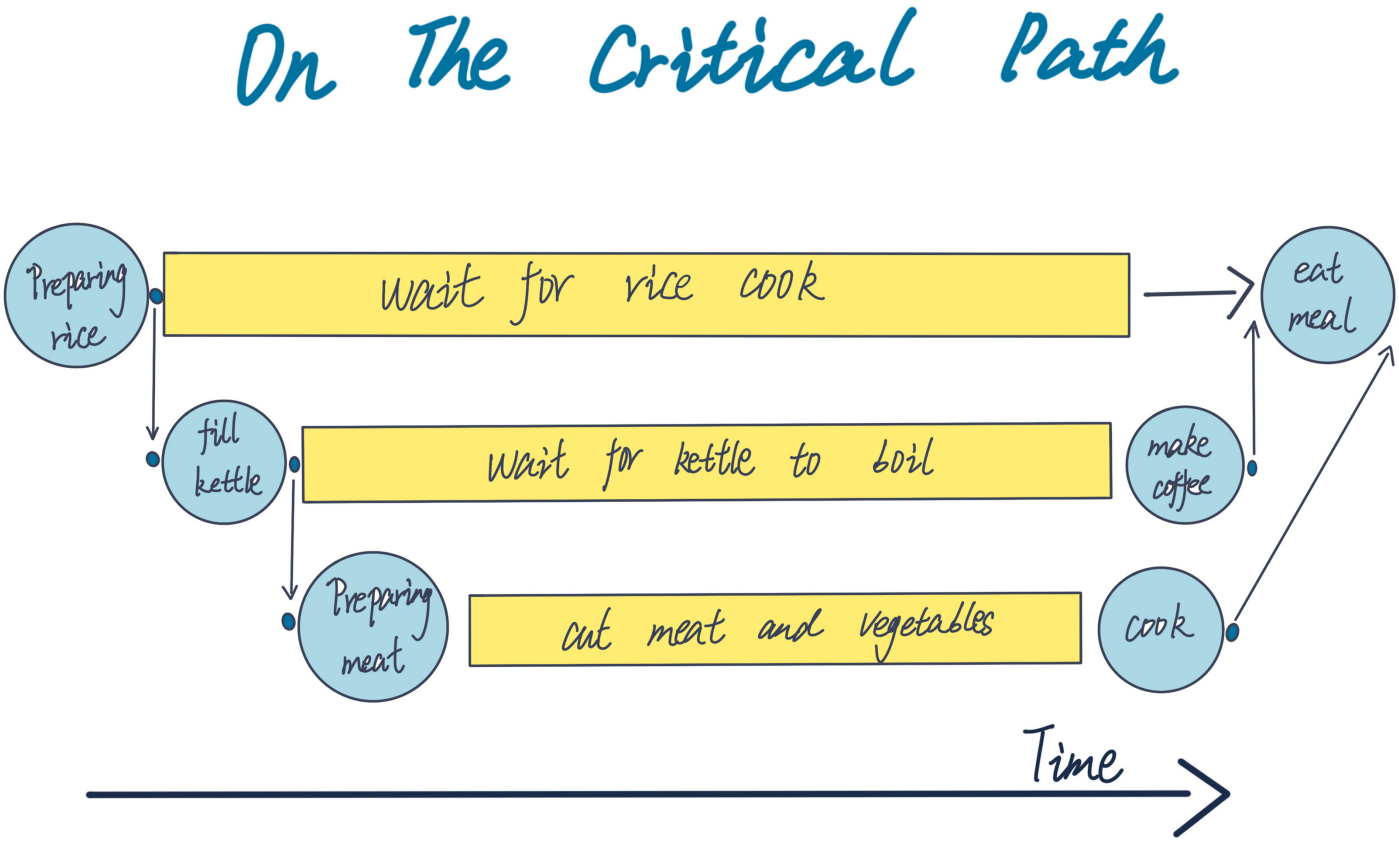
3.2 Time Planning

Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM) help managers to plan the timing of projects involving sequential activities.

PERT/CPM charts identify the time required to complete the activities in a project, and the order of the steps. Each activity is assigned an earliest and latest start time and end time.

Activities with no slack time are said to lie along the critical path–the path that must stay on time for the project to remain on schedule.

3.2.1 PERT /CPM


On The Critical Path
Preparing rice
wait for rice cook
eat meal
fill kettle
wait for kettle to boil
make coffee
Preparing meat
cut meat and vegetables
cook
Time

3.2.1 PERT /CPM

A dummy activity is used in the network to show a precedence relationship, but it does not represent any actual passage of time.

A design brief is a written document for a design project developed by a person or team (the 'designer' or 'design team') in consultation with the 'client'.

They outline the deliverables and scope of the project including any products or works (function and aesthetics), timing and budget.

They can be used for many projects including those in the fields of architecture, interior design and industrial design.

Design briefs are also used to evaluate the effectiveness of a design after it has been produced and during the creation process to keep the project on track and on budget.

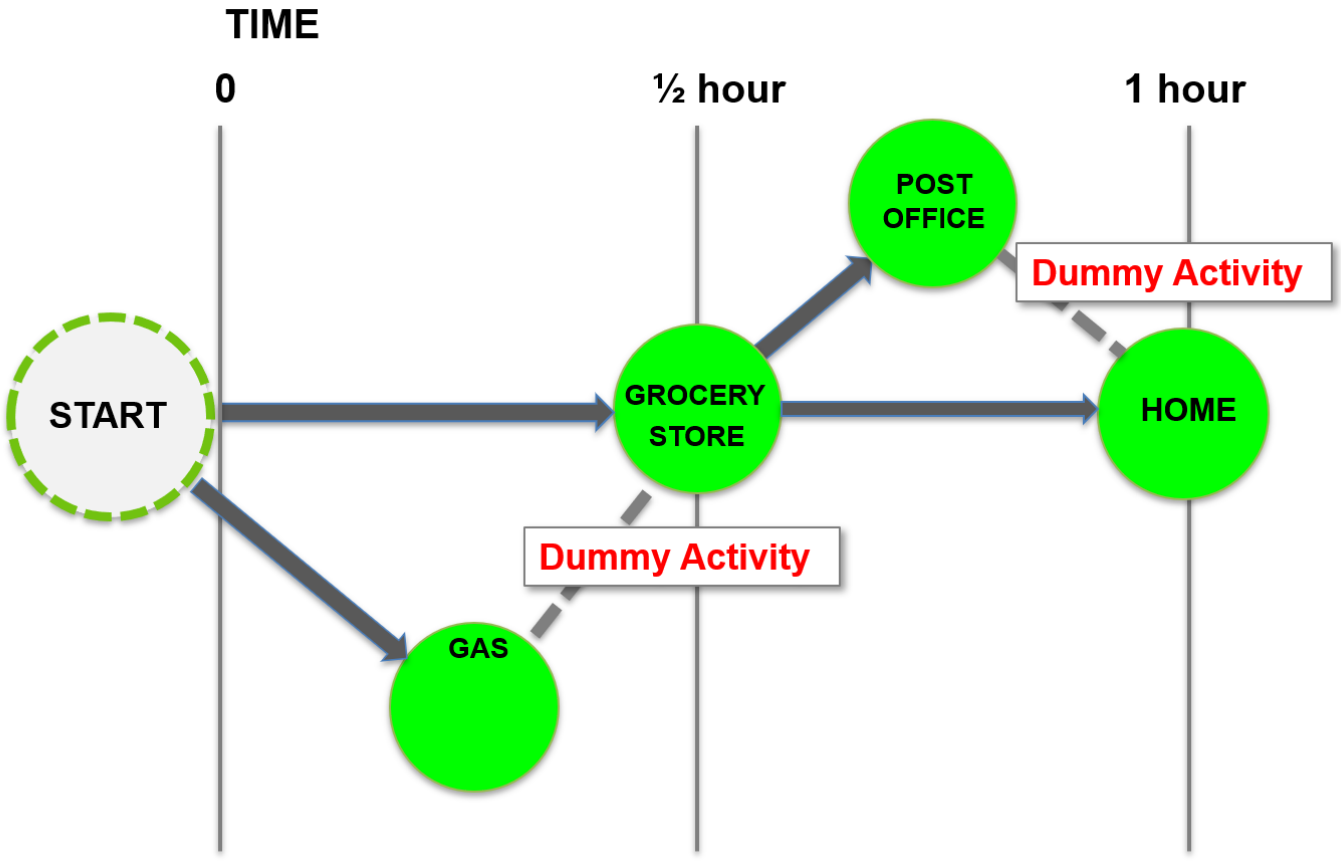
Some firms rely on them more than others but there is a move towards greater accountability in the design process and thus many people find them most useful.

They usually change over time and are adjusted as the project scope evolves.

Often they are 'signed off' by the client and designer at set stages in the project.

3.2.1 PERT /CPM


RESEARCH
DESIGN RESEARCH
Problem Statement
Define Purpose of Study
Formulate Hypotheses
Timeline
Perchart
Anylize Previews Researches
Start Jounal
Define Research Type
FIELD STUDY RESEARCH
Surveys
Meet panel of Experts
Community Garden
Site observation
Conservatory of Flowers
Nursery
LITERATURE RESEARCH
Internet
Old Research Reports
Journals
Books
MID-TERM PRESENTATION
Create 3 Personas
Create Scenario
Design Presentation
Give Presentation
8.12.2010
SYINTESIZE DATA
Organize Information
Study the Problem
Answer the Problem
Write Chapter 1, 2, & 3
PROTOTYPE MOCK-UP
Ideation
Get Feedback
Consrtuct
Test

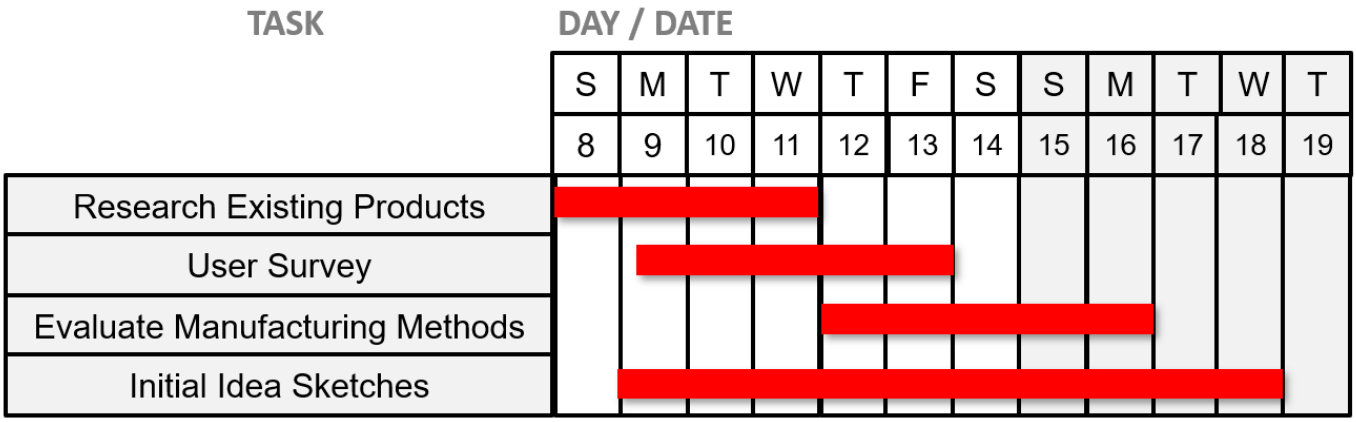

TIME
0
½ hour
1 hour
START
GROCERY STORE
POST OFFICE
HOME
GAS
Dummy Activity
Dummy Activity

3.2.2 GANTT Chart

A Gantt chart is a type of bar chart, adapted by Karol Adamiecki in 1896, and independently by Henry Gantt in the 1910s, that illustrates a project schedule.

Gantt charts illustrate the start and finish dates of the terminal elements and summary elements of a project.

3.2.2 GANTT Chart



3.3 Venn & Euler Diagrams

Euler and Venn where both well versed in Mathematics.
As Industrial Designers we use both diagrams.
DON'T be restricted to using just one and there may be relationships that surface later.

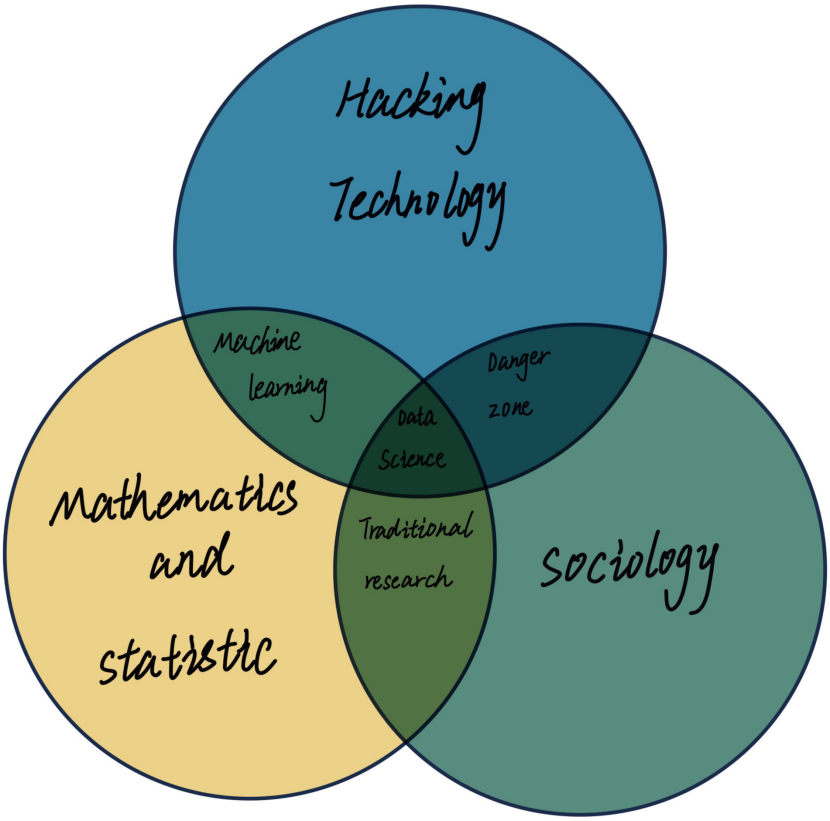
Mathematician John Venn was born in Hull, England, in 1834. ... He is best known for Venn diagrams, pictorial representations of the relations between sets that have become an oft-used tool in the teaching of mathematics and logic, among other concepts.

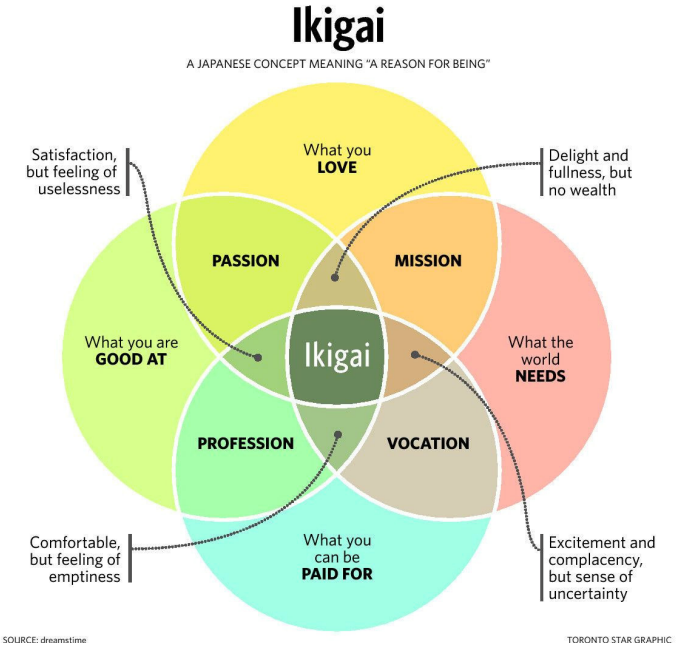
Venn died in Cambridge in 1923.May 14, 2019

Leonhard Euler was born on April 15, 1707, in Basel, Switzerland.

Though originally slated for a career as a rural clergyman, Euler showed an early aptitude and propensity for mathematics, and thus, after studying with Johan Bernoulli, he attended the University of Basel and earned his master's during his teens.

3.3/3.3.1 Venn & Euler Diagrams

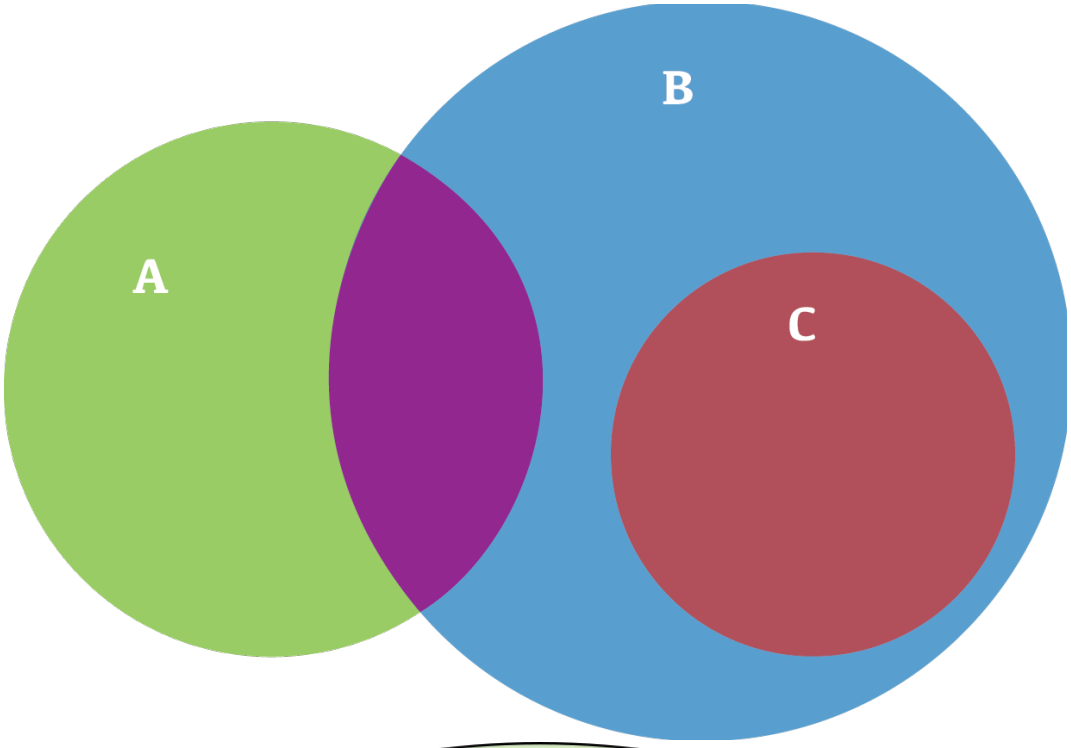


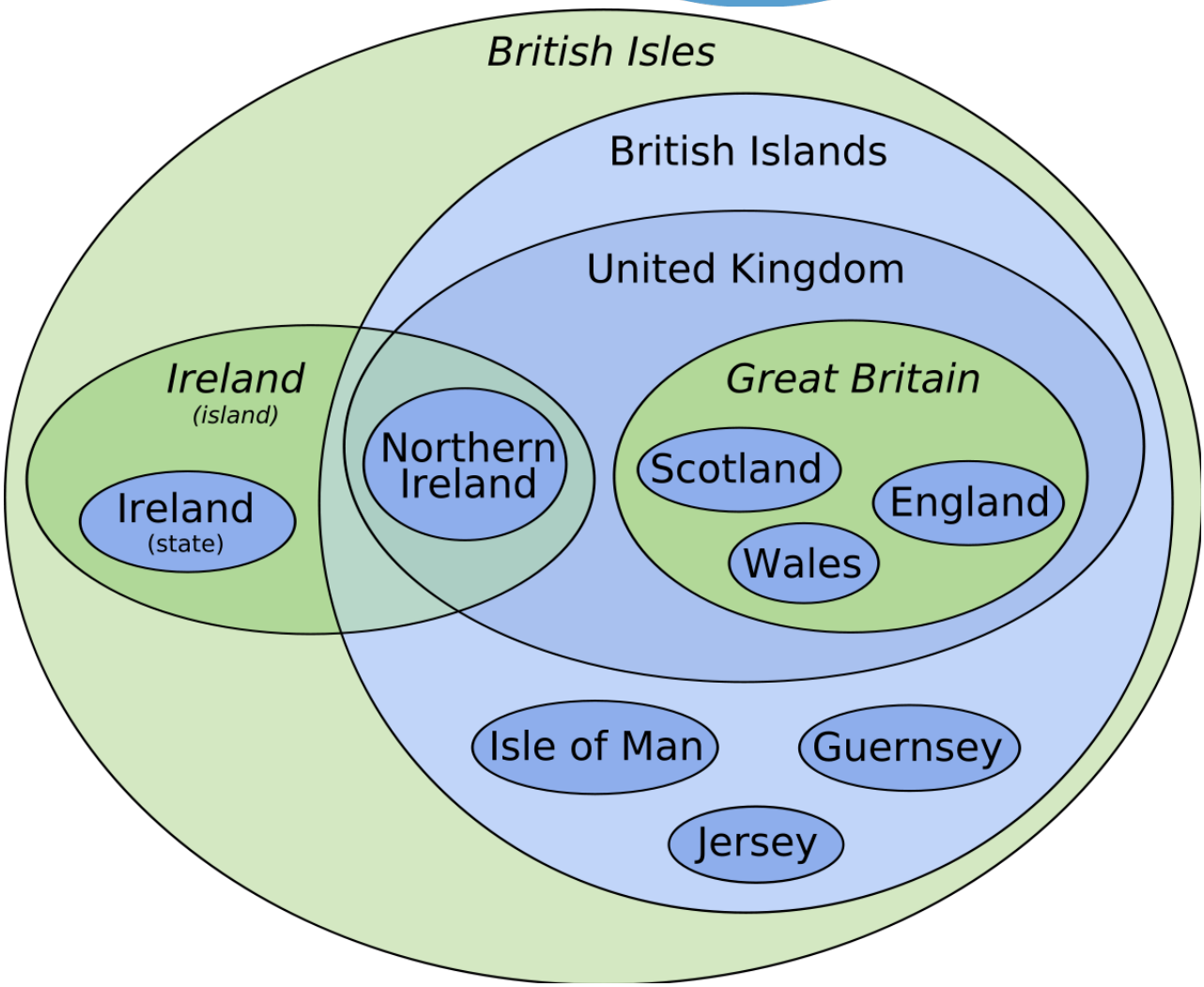


3.3.2 Euler Diagrams

Euler- wanted to show interrelationships as well as hierarchy.

3.3.2 Euler Diagrams





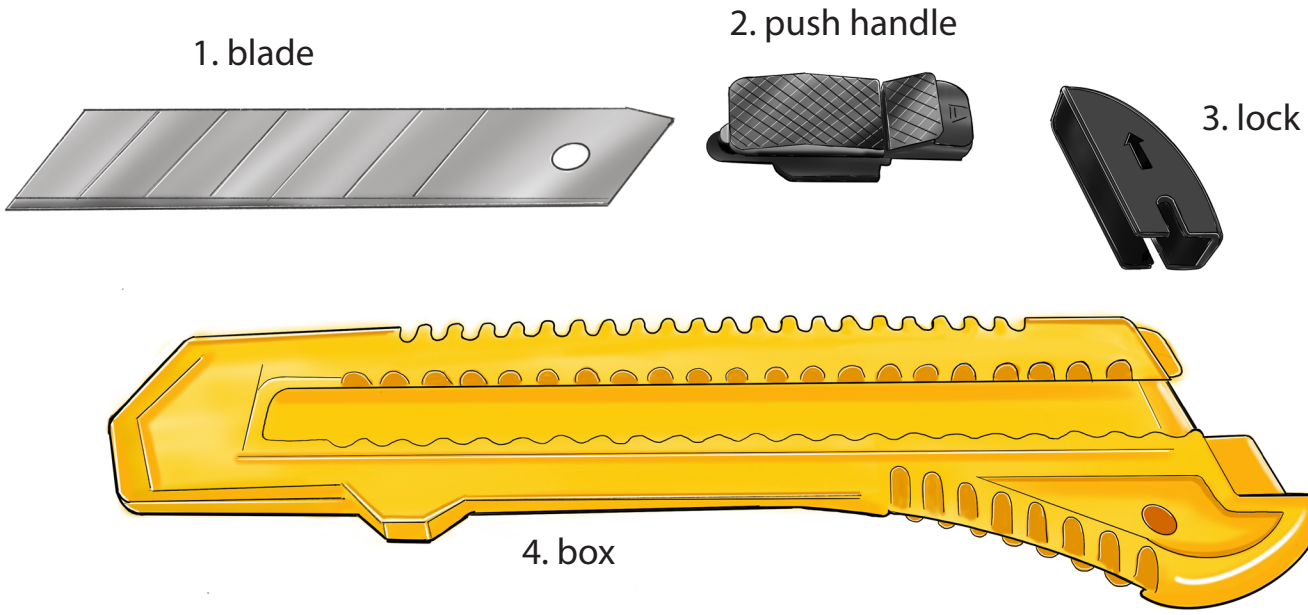
3.4 Exploded View

Exploded views are typically used in a redesign project.They show physical interaction of the elements of the product or system.Exploded views help those who are not trained in reading engineering drawings to readily understand the assembly of the product or system.

Collect and produce information. Disassemble your device an create an explode view of the parts. Make sure that the drawing communicates how the parts fit together.Train yourself in operating the object. Examine each part as to how it relates to the user.

Analyze and classify information.Name and number each part, sub-assembly or component. Define constraints. Identify which parts that can be modified or redesigned.

3.4 Exploded View



number	name
1	blade
2	push handle
3	lock
4	box

3.5 Interaction Matrix

Interaction Matrix

The aim is to conduct a systematic search for connections: B e t w e e n p r o d u c t elementsBetween these elements and design factors

The degree of interaction is denoted by a 0, 1, or 2

0	no interaction
1	light or infrequent interaction
2	high frequency of interaction

3.5.1/3.5.2 Interaction Matrix

parts	1	2	3	4	5	totals
blade	0	0	0	0	1	1
hilt	2	2	2	2	2	10
box	2	2	2	2	2	10
cover	0	0	0	1	1	2

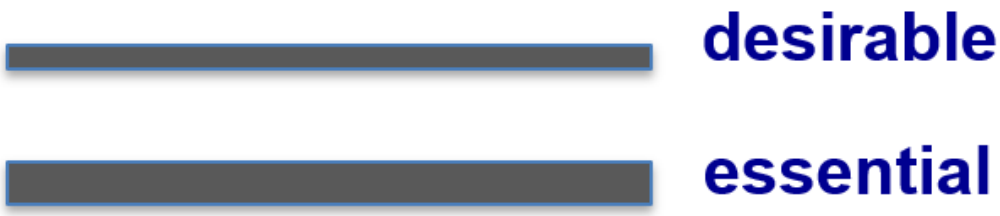
	blade	hilt	box	cover	direct	indirect
hand	0	1	1	1	3	1
eye	1	1	0	0	2	2
ear	0	0	0	0	0	4

3.6 Interaction Net

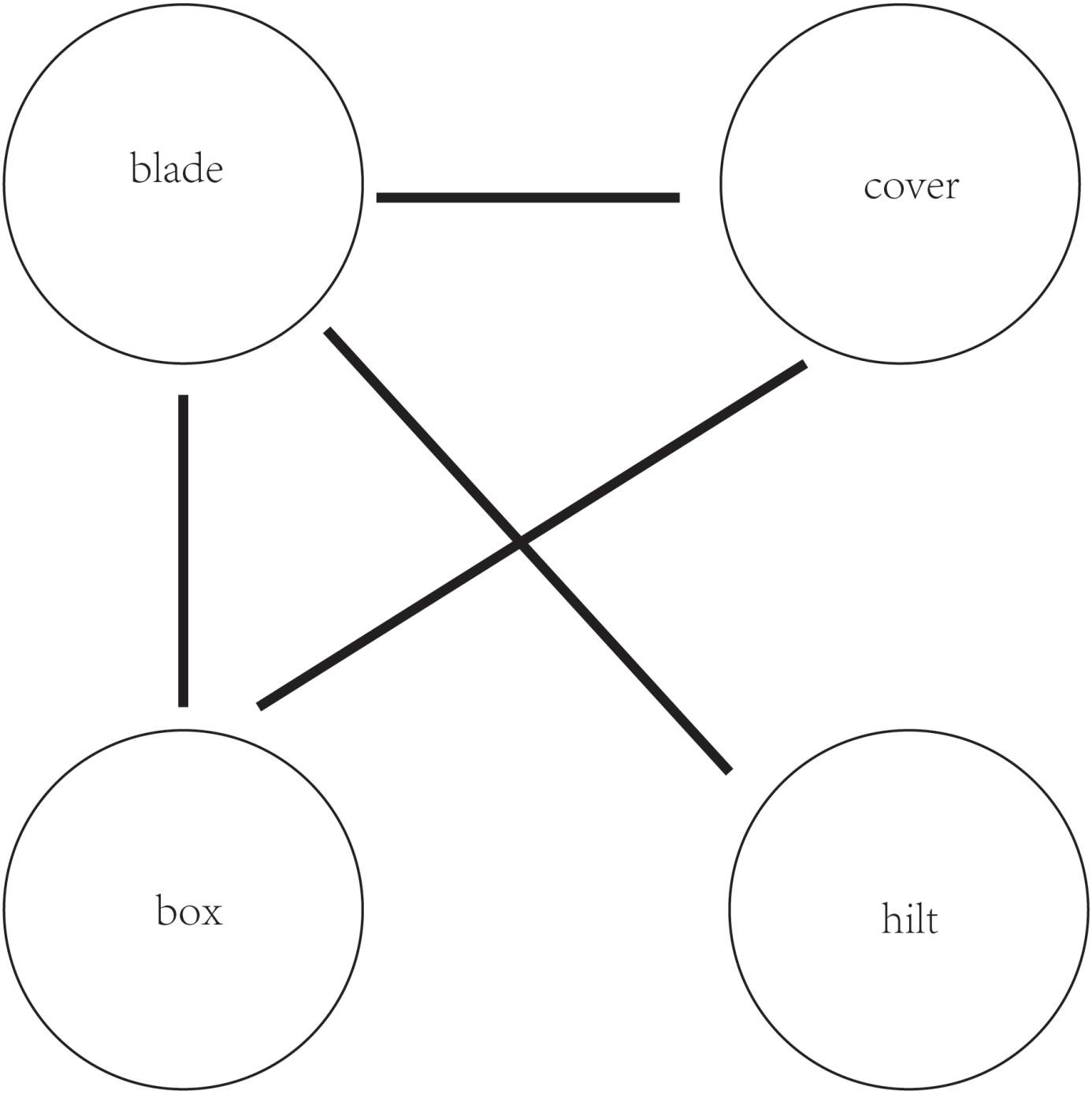
Interactions are used to structure problems. reciprocal action, effect, or influence. Nets are tools to structure interactions between elements.

Use the elements (parts) from the Interaction Matrix. Use a circle for each part, number the circle to correspond with the part and arrange in a circle.

Connect the elements (parts) to each other using a series of lines. The lines are to be two widths representing the following:



3.6 Interaction Net



3.7 Hierarchical Tree Structure

Tree Structures break down the elements of a system into different levels.

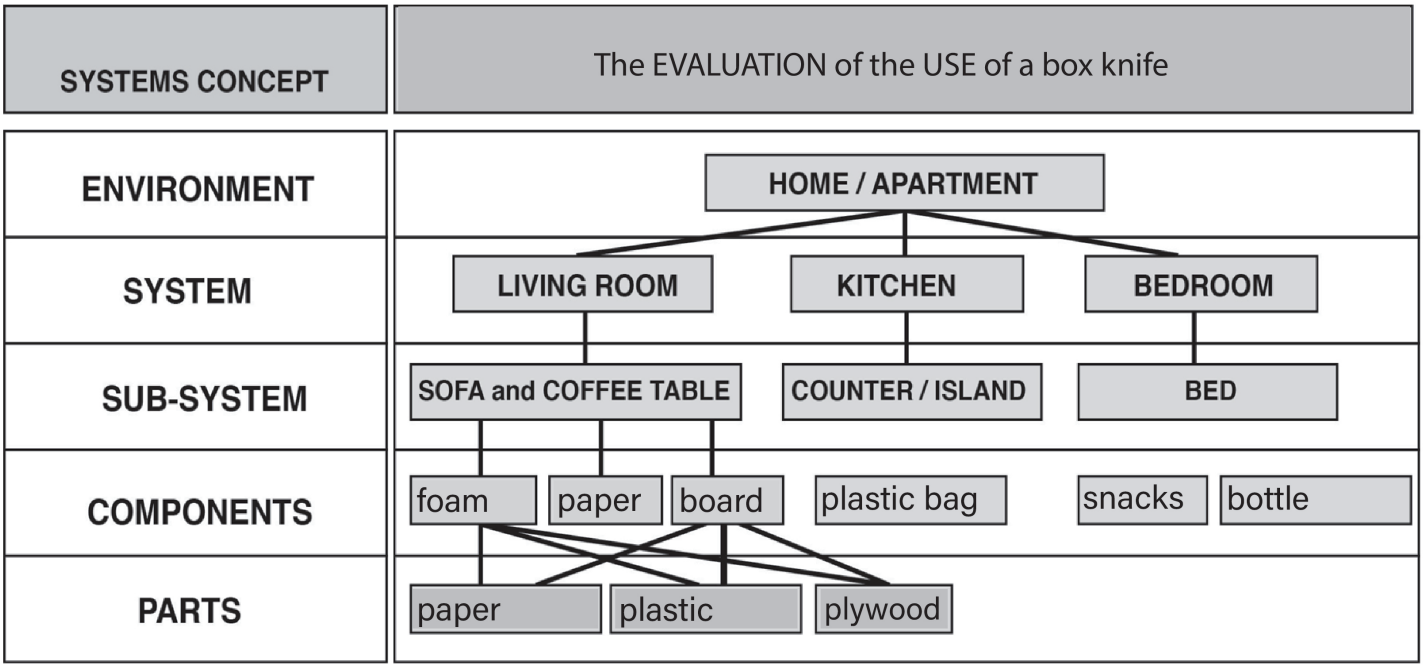
A tree structure or tree diagram is a way of representing the hierarchical nature of a structure in a graphical form.

This tool is one of the best tools for organizing elements in their levels of hierarchy.

The Systems Concept and Hierarchical Tree Structure

The Systems Concept consists of five elements.
Environment
System
Sub-System
Components
Parts

3.7 Hierarchical Tree Structure



3.8 Block Diagram and Mind Mapping

Block diagrams show certain relationships within physical objects and environments.

Block diagrams consist of all types of relationships.

They show direct or indirect relationships and one-way and two-way interactions.

And they show hierarchical and overlapping relationships.

A typical legend for a simple block diagrams consists of the following:

DIRECT
RELATIONSHIPS
OVERLAPPING RELATIONSHIPS
ONE WAY
RELATIONSHIP

Block diagrams are typically used for higher level, less detailed descriptions that are intended to clarify overall concepts without concern for the details of implementation.

A powerful graphic technique which explores the potential of the brain in problem solving.

Originated in the late 1960s by Tony Buzan, to improve from linear thinking approaches.

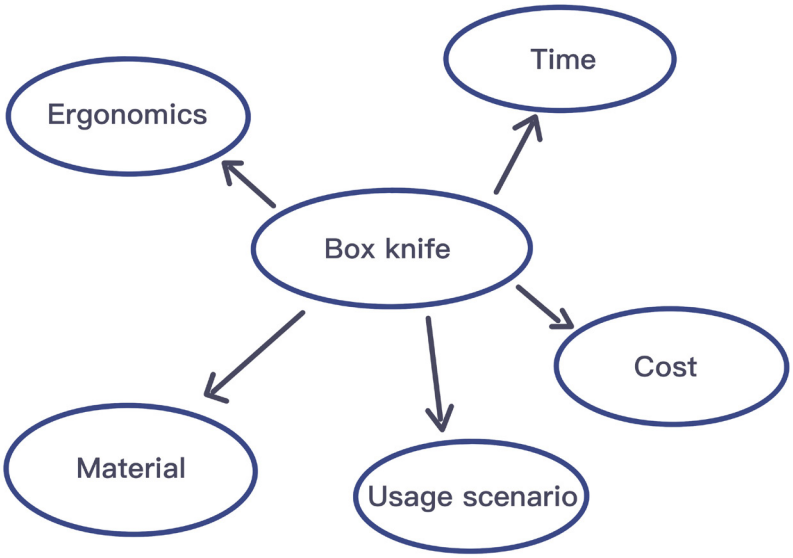
Incorporate full range of cortical skills – word, image, number, logic, rhythm, color and spatial awareness.

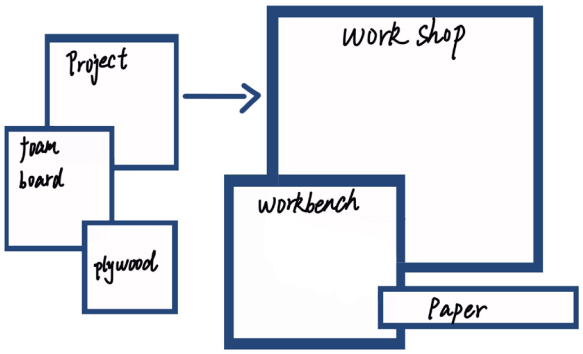
Mind mapping is applied by various disciplines to enhance thinking performance.

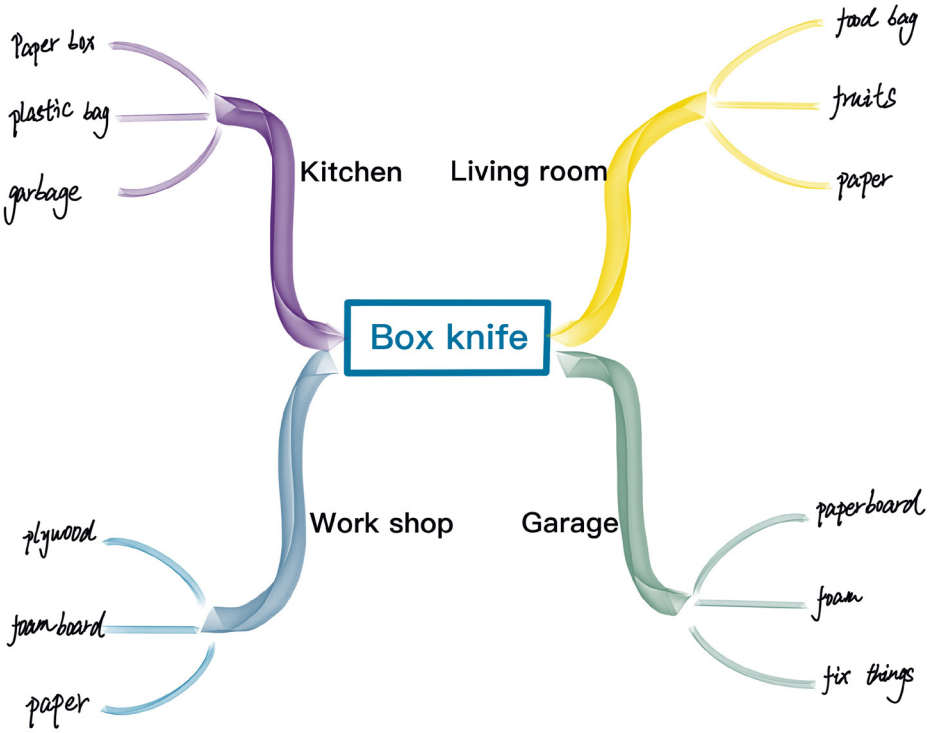
Concepts of MINDMAPPING
Structure of ideas ,Key Words ,Association ,Clustering ,Visual Memory ,Outstanding Center

What is a Mind Map?
…a highly effective way of getting information in and out of your brain
…it is a creative and logical means of note-taking and note-making that literally "maps out" your ideas.
…converts a long list of monotonous information into a colorful, memorable and highly organized diagram that works in line with your brain's natural way of doing things.

3.8 Block Diagram and Mind Mapping







3.9 Flow Chart

Study the sequence of how a product is used

Analyze the "point of contact" in a dynamic way

Identify potential problems associated with the usage

Create design components for each step

Enhance user experience from improving the sequence

Important analysis especially for designing product control and information systems

A flow chart is a graphical or symbolic representation of a process.

Each step in the process is represented by a different symbol and contains a short description of the process step.

The flow chart symbols are linked together with arrows showing the process flow direction.

A Flow Chart shows a process – the operation of an object or system.

The Flow Chart works on an input and output diagram with the throughput as the actual process.

Throughput: the amount of material, data, etc., that enters and goes through something (such as a machine or system)

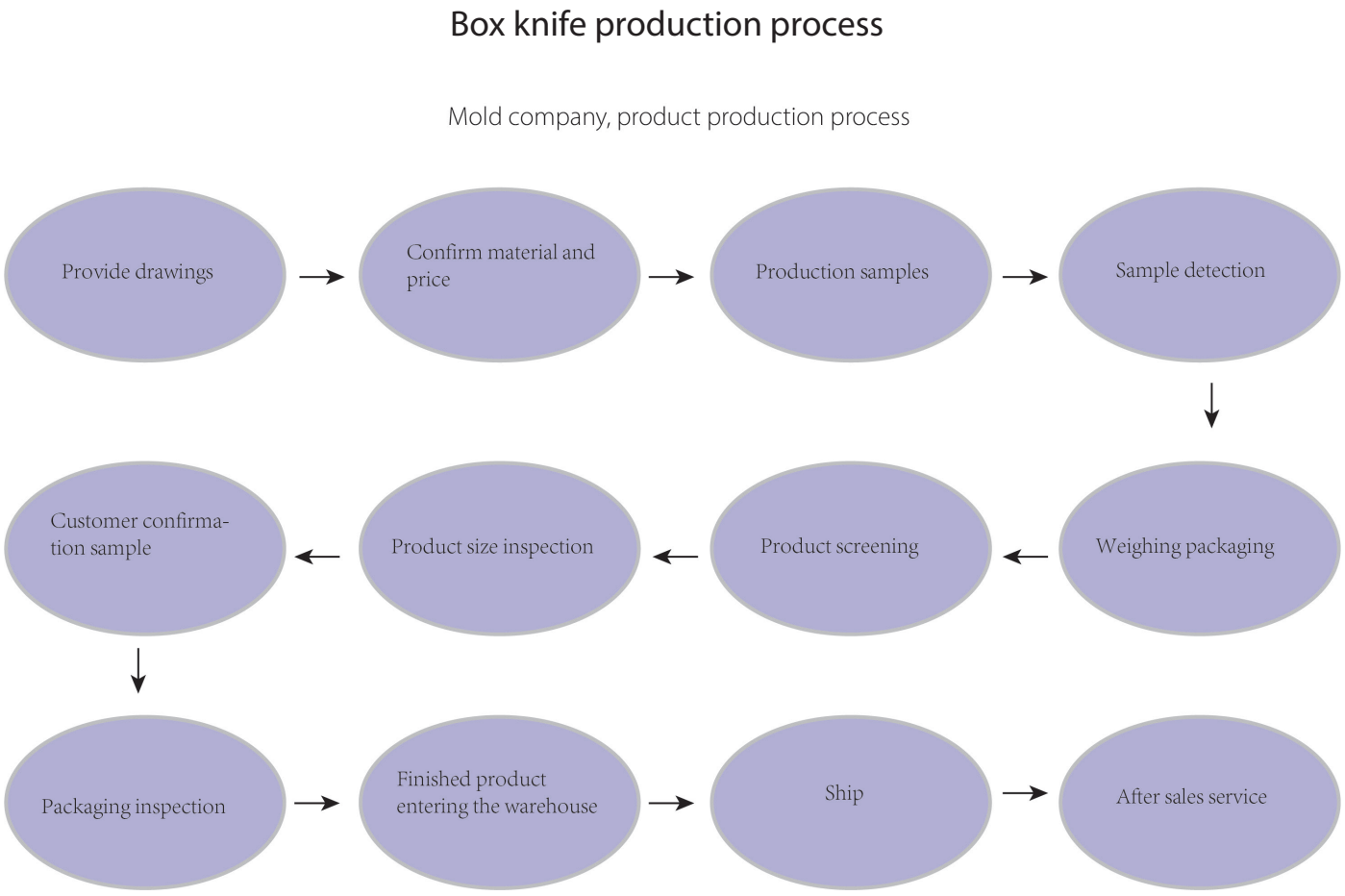
The throughput is concerned with with decisions – yes or no.

Terminator, shows the start and stop points in a process. When used as a start symbol, terminators depict a trigger action that sets the process flow into motion.
Process, Show a Process or action step. This is the most common symbol in both process flowcharts and business process maps.
Decision, Indicates a question or branch in the process flow. Typically, a Decision flowchart shape is used when there are 2 options (Yes/No, No/No-Go, etc.)

Create a flow chart using your product. Develop a scenario and show the flow of a process that incorporates using your product.

Be sure to have a terminal point at the beginning and end. Use the symbols that best represent the flow of using the object.

3.9 Flow Chart



3.10 Sequence of Use Chart

Study the sequence of how a product is used. This very similar to a Flow Chart, but it is typically based on the path with no interruptions during the process.

It is the steps, the sequence of events that are required and those that have minimum or no interruptions.

The Sequence of Use Chart works with the Flow Chart. It is self explanatory – a realistic visualization – a series of images showing the use in a sequence.

Designers use both the inductive and deductive approach to solving problems.

inductive – reasoning from the parts to the whole

deductive – reasoning from the whole to the parts

The Sequence of Use Chart follows the inductive approach, looking at the steps as parts to the whole process.

This process allows the designer to look at each step by evaluating the steps though images and text descriptions.

Create a Sequence of Use chart using your product. Show the step by step process of how your product is used.Use the critical path or the path with no interruptions of the Flow Chart as a guide. Take photographs of the process.Number each step and write a description of the action for each step.

3.10 Sequence of Use Chart

1. Using a box knife

2. push the handle

3. lock the blade

4. cut

5. pull back the blade

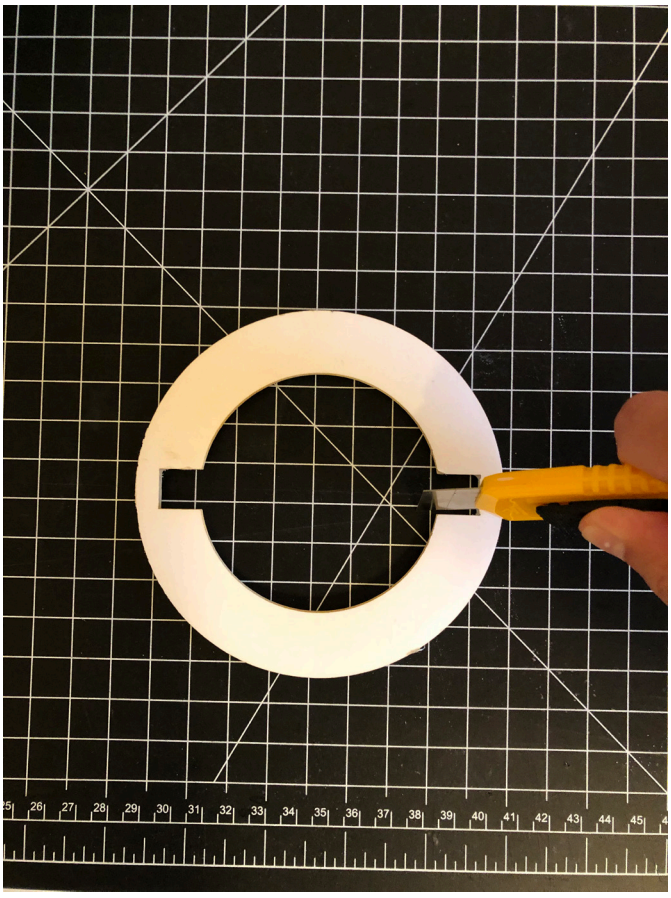
3.11 Frequency Chart

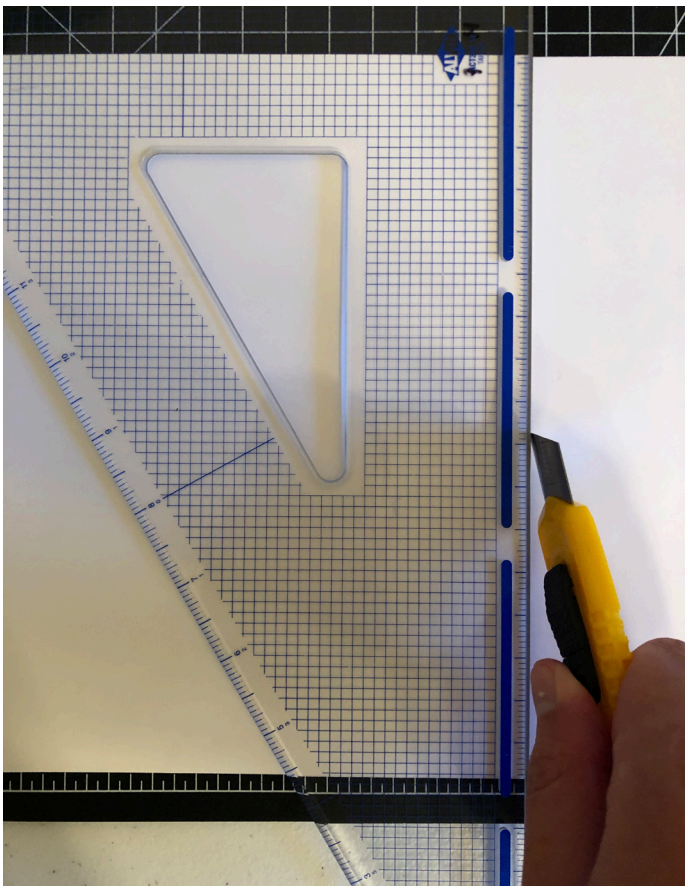
Frequency is how often an action occurs; something occurs over and over again.

A Frequency Chart shows the frequency of an event or action.

Observation and experiments are used to gain data that is used in the chart.

Two types of Frequency Charts:
1. Numerical Frequency Table
2. Visual Frequency Chart



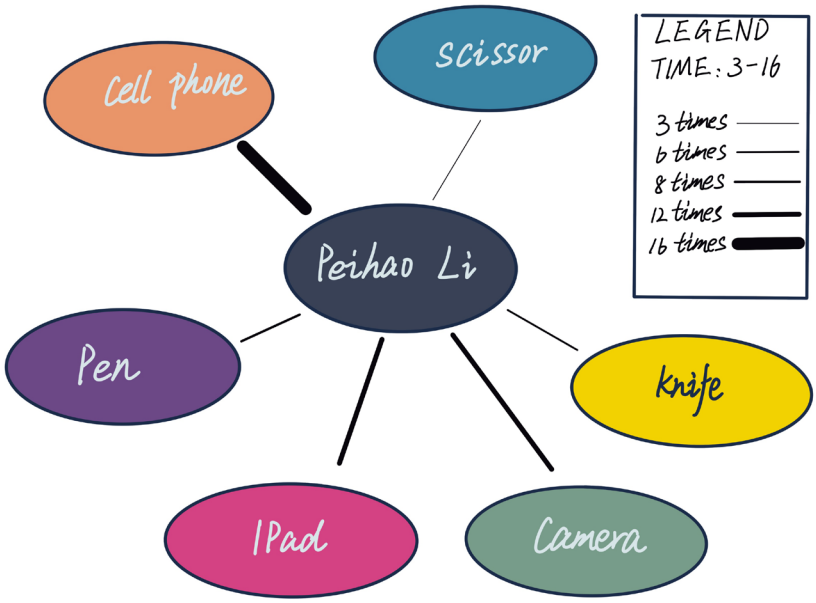


3.11 Frequency Chart

Numerical Frequency Chart

TIME	Camera	Knife	Scissor	Pen	IPad	Phone
3 to 6	1	0	0	2	0	2
6 to 9	2	1	0	1	2	3
9 to 12	0	3	1	1	3	3
12 to 16	0	0	0	1	3	4
TOTAL	3	4	1	5	8	12

Visual Frequency Chart



3.12 Right – Wrong Chart

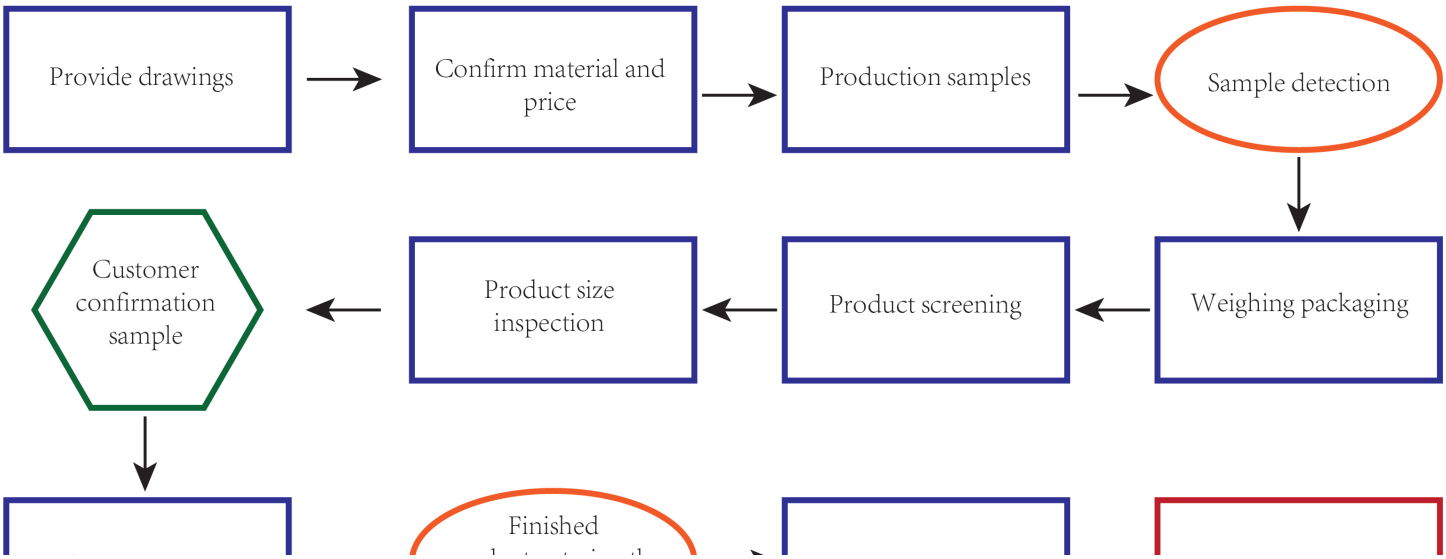
The Right – Wrong chart is used for physical objects and non-physical activities.

The Right – Wrong chart is an evaluation tool for establishing recommendations for further design studies.

3.12 Right – Wrong Chart

Box Knife Production Process

Mold company, product production process



3.13 Human and Technical Function Complexity Graph

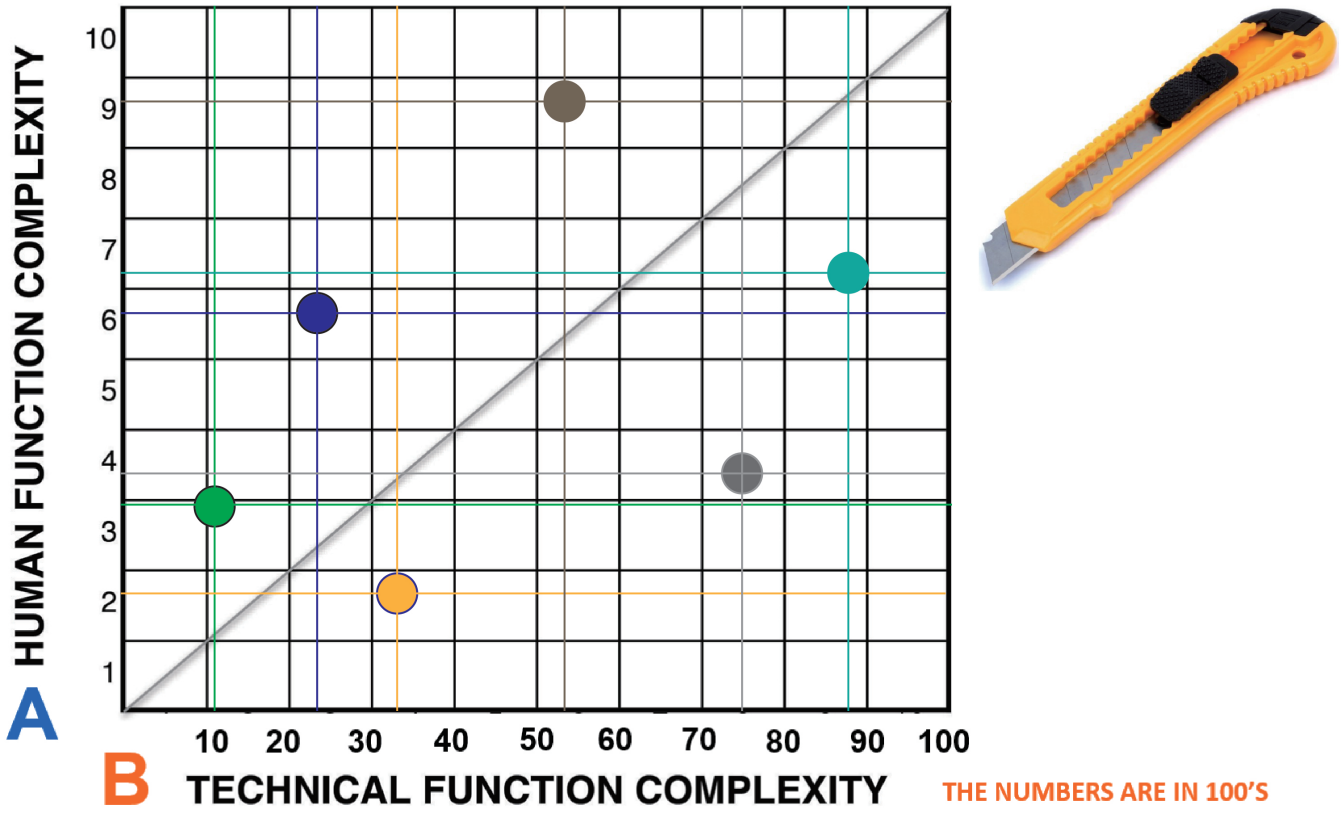
Products and systems can be graphed in terms of Human and Technical complexity.

The more time, images or words needed to describe something the more complex it becomes.

Human Function Complexity
User Experience and Interface

Technical Function Complexity
Product components, elements and parts.

3.13 Human and Technical Function Complexity Graph



3.14 Product Positioning Chart

To analyze the relative market position of existing products or brand on critical aspects to help establish a competing strategy.

Understanding where your product fits within the market is critical to its success.

A Product Positioning Chart is an effective tool that designers and marketers use.

Placing products and/or services on a grid based on two variables, such as price or quality allows the design team to see where there are gaps in the market and where a product or service might fit.

Product positioning is an important element of a marketing plan.

Product positioning is the process marketers use to determine how to best communicate their products' attributes to their target customers based on customer needs, competitive pressures, available communication channels and carefully crafted key messages.

Identify two critical design variables of a product as the X and Y axes of the positioning map

These design variables could be identified in
Human function
Technical function
Production function

Mark the position of each competitor along the X and Y axis based on their position of these variables.

Determine your relative position in the map.

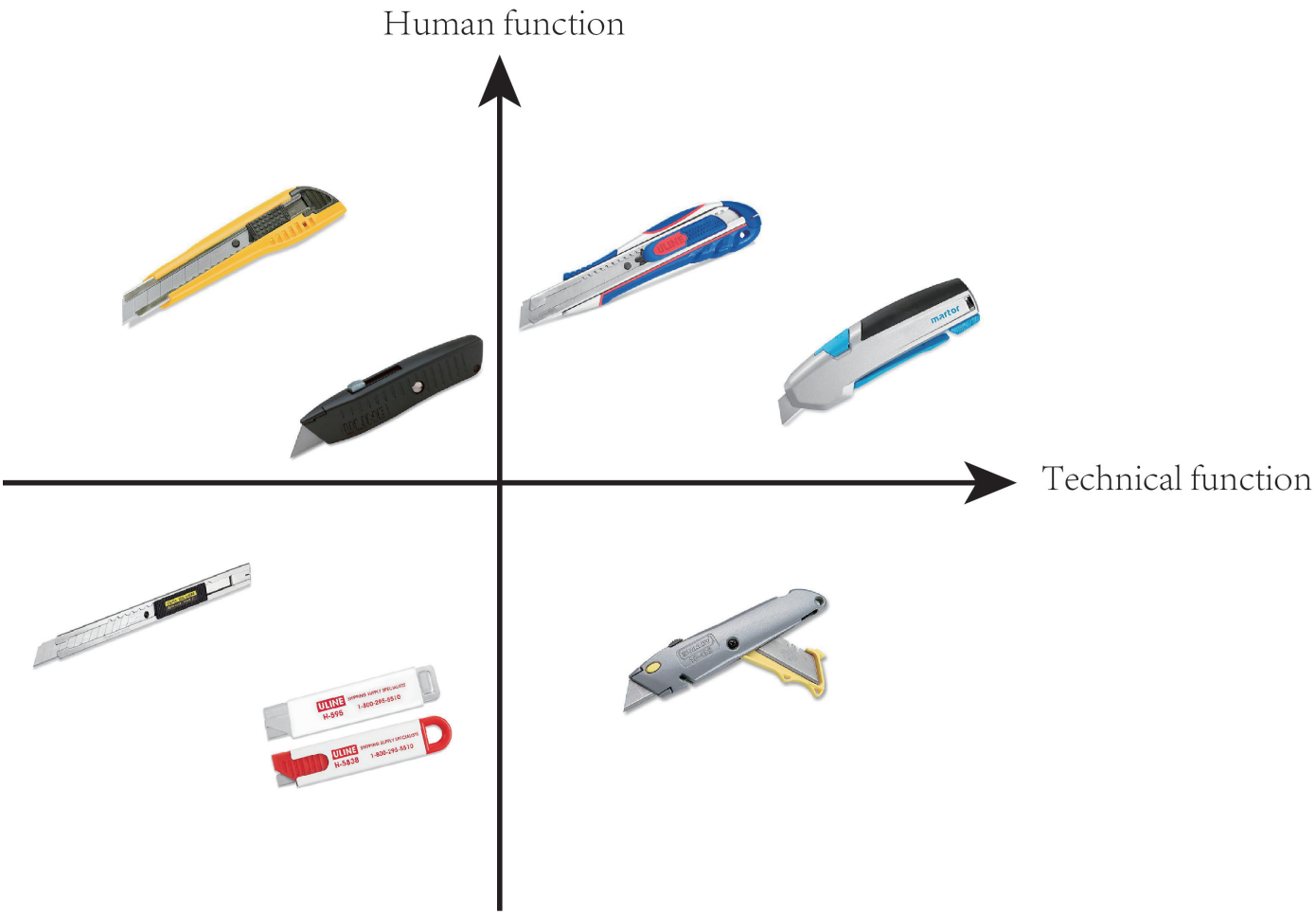
Different positioning maps can be developed based on different combinations of variables.

This chart shows the retail market today and the art of retail branding. Competitive positioning, brand promises, segmentation strategies and the influx of online retailing are shown.

Where is the retail market heading?

With news of poor sales and store closings, where can retailers go from here?

3.14 Product Positioning Chart



3.14.1 Patents – Utility and Design

In general terms, a “utility patent” protects the way an article is used and works, while a “design patent” protects the way an article looks. The ornamental appearance for an article includes its shape/configuration or surface ornamentation applied to the article, or both.

The term of a design patent is 15 years, measured from the date the patent is granted. This is in contrast to a utility patent term, which typically lasts 17 years and is measured from the application priority filing date.

A design patent protects any new and original ornamental design of an article of manufacture.

ABSTRACT
The present invention relates to a single-hole puncher with ease of alignment comprising a base and a punching unit; the punching unit is disposed on the base; a hole is disposed on the base in a position corresponding to the punching unit; a L-shaped right-angle receptacle with two vertical flanges is disposed between the base and the punching unit; the punching unit and the right-angle receptacle are vertically disposed facing each other.

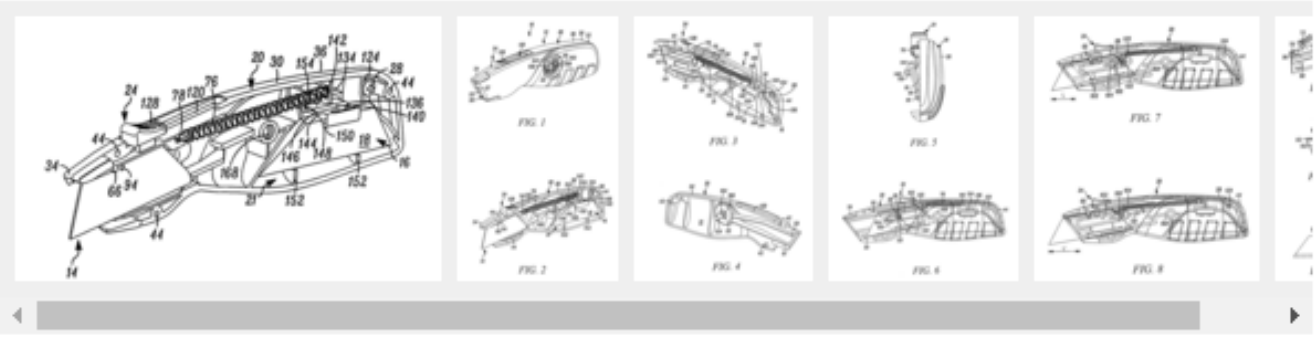
3.14.1 Patents – Utility and Design

Self-retracting utility knife

Abstract

A utility knife includes a housing and a blade carrier movably mounted to the housing. The blade carrier includes a blade supporting surface for supporting a blade, wherein the blade carrier is movable between a retracted position with at least a substantial portion of the blade retracted in the housing, and a first extended position with at least a portion of the blade extending outwardly of the housing. An actuator is operably connected to the blade carrier and is operable to move the blade carrier between the retracted and extended positions to, in turn, move a blade located on the blade carrier between the retracted and extended positions. A biasing member biases the blade carrier toward the retracted position. A stop member is movable between a first position and a second position. In the first position, the stop member is engagable with the blade carrier to thereby limit extension of the blade carrier and blade located thereon to a second extended position spaced inwardly on the housing relative to the first extended position. In the second position of the stop member, the stop member is spaced away from the blade carrier to thereby permit movement of the blade carrier and blade located thereon to the first extended position.

Images (6)



Classifications

B26B5/001 Hand knives with one or more detachable blades with blades being slid out of handle immediately prior to use

View 1 more classifications