PDHonline Course G236 (4 PDH)

How to Invent by the NCMR Method

Instructor: John R. Andrew, P.E.

2020

PDH Online | PDH Center

5272 Meadow Estates Drive
Fairfax, VA 22030-6658
Phone: 703-988-0088
www.PDHonline.com

An Approved Continuing Education Provider

How to Invent by the NCMR Method

John Andrew, P.E.

CONTENTS

About This Course

This 4 PDH course describes the NCMR inventing method. The history of inventions reveals the method of inventing. Inventors apply the discoveries of science to technology. Entrepreneurs bring technology to the market place. This brief and to the point course explains how to invent. The NCMR creativity method is presented with illustrated examples. The reader is encouraged to complete the various innovation exercises. Methods are presented here showing how to: **Find a need and invent something that meets that need.**

1.0 Inventors Create Wealth

The creativity of inventors and entrepreneurs are the root source of our wealth. Their innovations have changed the United States from a relatively poor farming country 100 years ago, into an extremely wealthy industrialized nation today. Every: new car, cell phone, or other product sold increases wealth. Each product requires a service to sell and maintain it. The poverty seen in under developed areas is due to the lack of goods and services found in more prosperous regions.

The related course by the same author, "Applying for a Patent Online" is also available at www.PDHonline.com.

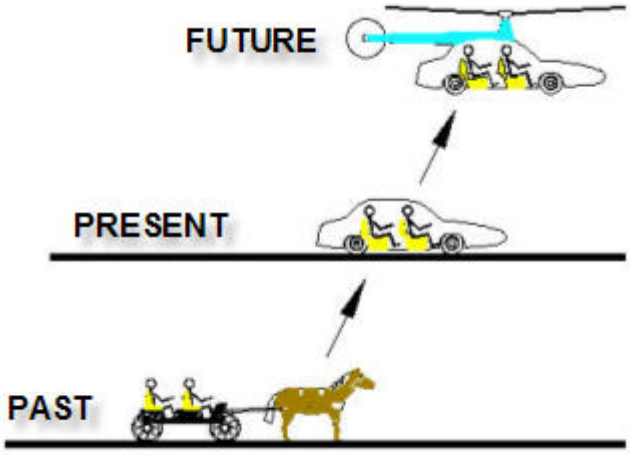
1.1 Innovation in Industry

The Dana corporation has 80,000 employees and each is requested to give 2 new ideas per month. 80% are incorporated. Companies pay an average fee of $350,000 for a 30 second commercial on national TV. The list below indicates what leading corporations are saying about innovation:

Commercials on National TV	
HEWLET PAKARD	**Invent**
CADILAC:	**Breakthrough**
FORD:	**Built For the Road Ahead**
CHRYSLER	**Inspiration Comes Standard**
ACURA	**Never Follow**
SUBERU	**Recreated Outback**
GENERAL MOTORS	**It's not more than you need. It's just more than you're used to.**
SHELL	**Waves of Change**
GENERAL ELECTRIC	**Imagination at Work**
SONY LAPTOP	**Like No Other**
DISNEY	**Imagineering**
LOWES	**Improving Home Improvement**

1.2 Innovation Paths

Sales of the Model-T Ford dropped after 15 million were sold. All were painted black. Competing auto makers offered: other colors, improved styling, comfort, and reliability. High volume standardized products can be very profitable. However the public ultimately chose to buy competing products with improved features, even if they cost more. Almost all enterprises and their products must progress along an innovation path or they will become obsolete.



1.3 Horse and Buggy to Car-Copter

An innovation path from: horse and buggy (Past) to automobile (Present) to car-copter (Future) is illustrated above. The trend is the increase of invention complexity.

1. All inventions combine items that exist in the past.
2. These items are modified to function together in the present.
3. The new invention formed by this process becomes available for future use.

1.4 Benefits of Inventions

The steam engine, invented by James Watt in 1800, started to drive machinery, pull long trains across continents, and push huge ships across oceans. Engine power, first steam and now gasoline and diesel moved the labor force from mainly farming to manufacturing: cars, TVs, computers, cell phones, medications, and all that goes with a multi-trillion dollar economy. Much of what we think, see, and do is affected by inventions. Let us appreciate the many needs that inventions have satisfied. Let us enjoy creatively working together to bring more beneficial inventions into the future that will provide a better quality of life for more people.

Food – Clothing & Shelter

Comfort -- Security & Reduced Suffering

Education – Science & Art

Transportation -- Fuels & Electricity

Employment – Recreation & Prosperity

Bottom Line: Inventions Bring New Wealth and Better Health

1.5 Passive or Creative?

We become more creative as we spend less time being passive. Watching: TV, movies, and sports are passive activities. As we sit in front of the TV we are saying, “Entertain me.”

Passive VS Creative	
Read books	**Write books**
Look at pictures	**Paint pictures**
Listen to music	**Compose music**
Watch games	**Play games**

1.6 Mission, Vision, and Quality

What are the: mission, vision, and quality statements of successful inventors?

a. Questions can be more valuable than answers if they lead to new discoveries. Successful inventors focus on their most urgent needs and the needs of others. The mind has a subconscious computer that works tirelessly day and night to solve problems. That is why the answer to a financial or other need has come out-of-the-blue to many when least expected. See section 15.0 for more about this topic.

b. Most people over estimate what they can accomplish in one year and under estimate what can be done in five years. Inventors are in it for the long term.

c. A survey has shown that most successful innovators and entrepreneurs shared the wealth generated, with those who helped in the enterprise.

d. Profit sharing with shareholders and employees, everyone, in a business enterprise has been shown to improve quality, productivity, and reduce negative behavior.

e. Persistence is the key. If you can not solve a problem instantly do not give up. Allow time to think: hours, days, weeks, or many months may be required to develop a new idea.

1.7 Leadership Qualities

You need a team to win a team sport. Bringing an invention to the public requires a network that should include one or more: Inventors, Engineers, Accountants, Machine Tool Programmers, Lawyers, and Bankers or Risk Capital Groups. The members of the team may agree to wait until income is generated before any remuneration is received. Entrepreneurs have the ability to direct the actions of people to achieve a goal. Margaret Thatcher said, “Consensus is the lack of leadership”. Successful organizations promote a respectful work environment and win / win relationships between all associates.

2.0 NCMR Inventing Method

As far as the author knows, it is not possible to study for a degree in inventing in the U.S. today. Innovation is critical to the prosperity of our nation. The **NCMR** method specified here is a basic step toward understanding and implementing the inventing process.

Inventing is a mental process that innovates:

* using the emotion of **Need**,

* **Combining** existing items,

* **Modifying** them to fit, form and function together,

and the process of **Removing** unessential Items.

Inventing is: Need + Combine + Modify + Remove (NCMR)

2.1 Fit, Form, and Function

Fit : to conform correctly to shape or size in order to mate with adjacent objects.

Form: the size, shape, structure, material, surface finish and color of objects.

Function: actions contributing to a larger action including: quality, performance, endurance,

Inventors do not create something out of nothing.

Motivated by **Need** they: **Combine** existing items.

Modify the items to fit, form, and function together.

Remove unnecessary items.

2.2 Screw-Drill Example

Two operations are required to fasten sheet metal roof and wall panels.

A hole must be drilled through the metals being joined with a drill bit (center).

Then the screw (right) must be driven into the two parts.

The “Screw-Drill” invention (left) attaches a drill bit on the end of a screw.

This invention combines a drill bit with a screw.

Unnecessary portions of the screw and bit are removed to fit, form, and function together.

2.3 Three Levels of Need

Need is the driving force behind creativity.

Level (1) Physical Needs

We need to increase the world food supply. Improved crop production is being accomplished with genetic engineering and better fertilizers, soil tillers, and harvesters. Affordable housing and clothing are also basic needs in any society.

Level (2) Safety Needs

New more effective person and article locators are needed. Better self protection and crime deterrent devices are needed.

Level (3) Esteem Needs

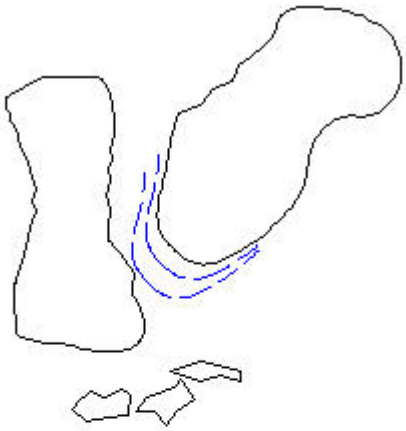
Esteem needs, in my opinion, include fulfillment; physically, mentally, socially, and spiritually. Communication and boundless information on the internet is helping to meet esteem needs.

2.4 World’s Greatest Needs

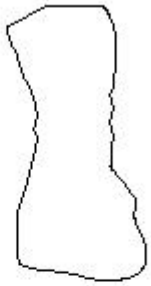
Inventions in the past, from the wheel to wonder drugs to the computer, have improved the quality of life for many. The poverty in under developed countries is due to the lack of equipment and services invented and in use in more prosperous areas. Note that most of these improvements did not come from governments. Inventors are the root source of wealth generating innovations. However there is room for much more improvement. The table below lists social and material needs today that can be satisfied with new innovations.

Greatest Social Needs	
A prosperous economy	**Cures for diseases**
Stable families	**Increase the energy supply**
College education for all	**Solve the pollution problem**
Feed the hungry	**Reduce crime**

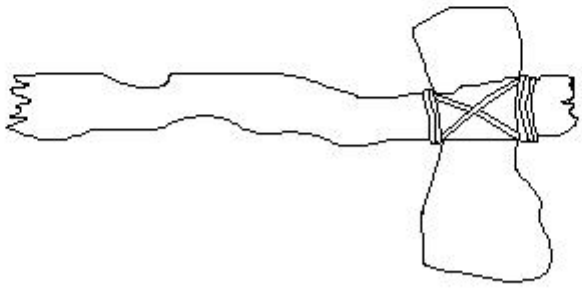
2.5 The First Inventions



CHIPPING STONE



CHIPPED STONE



EARLY AXE INVENTION

Primitive people were inventive when they chipped one stone against another to form cutting tools. They combined 2 rocks together and modified them to become a new invention. In this case a cutting tool. The cutting tool could be used to remove a branch from a tree. The branch was modified, using the new cutting tool, to form a club. The club would be used to kill game for food. The sharp stone facilitated the skinning process for clothing. The club was modified by splitting it at one end, and the sharp rock was combined with the club by inserting it into the split end and secured with leather thongs to form an axe.

As more inventions were created, so more items could be combined and modified to form more inventions. Today we have many millions of items that can be combined and modified to function together and unnecessary parts removed to form new inventions that satisfy needs.
Go to www.mcmaster.com and you will find the descriptions and prices of 435,000 industrial items. You will find: nuts, bolts, metals, plastics, tubing, shafting, motors, bearings, etc.

2.6 Inventions Satisfy Needs

It has been said that need is the mother of invention and war is the father.

Wars are credited with producing many inventions that now benefit the civilian community. The first fully automated food production processes was for biscuits supplied to the British navy. Where would commercial airlines be without radar invented to satisfy military combat needs. The internet was created because of the need for sharing government and military information. Global positioning GPS was invented to satisfy the need for locating enemy targets in the battle field. And the list goes on.

Inventions have improved the quality of life for many millions around the world. As conditions change in a society, needs change. All of the following inventions from the past are continuously being improved by a new army of inventors. Everything from computerized automobiles to jogging shoes are becoming more user friendly and more complex.

Item	Needs Satisfied
Aluminum Alloys	Aircraft - Engines - Car Parts
Battery	Car Starter - Radio - Flashlight - Calculator – Watch
Camera	Video, Record Keeping – Pictures
Computer	Typing - Databases - Spread Sheets - Drawings
Diesel Engine	Cars - Buses - Trucks – Ships
Electric Motor	Machinery - Car Starter + Windows + Seats
Electricity Generator	Lighting - Heating - Cooling
Gasoline Engine	Cars - Buses - Trucks – Boats
Heat Resistant Glass	Cookware - Chemical Industry
Laser	Measurement - Manufacturing - Surgery - Weapons
Loom	Cloth - Fabrics – Carpets
Man Made Fibers	Clothing - Aircraft - Heat / Sound Insulation
Motor Car & Truck	Transportation - Cargo Delivery
Paper	Copy Paper - Writing Paper - Book Pages
Plastic	Bottles - Containers - Cabinets - Furniture - Packaging
Printing Press	Books - Education - Magazines – Newspapers
Refrigerator	Food Storage - Food Processing
Radio	Communication - Entertainment - News - Sports – Music
Robots	Assemble, Weld, Paint, Test
Satellites	Radio - TV - Computer - Telephone
Sewing Machine	Clothing – Upholstery
Solar Cell	Calculators - Satellite Batteries
Solenoid	Car Power Locks - Valves
Steam Turbine	Electrical Power - Trains - Ships
Stainless Steel	Cutlery - Utensils - Food Processing - Chemical Industry
Telephone	Mobile Communication (Cell Phone)- Security (911)
Transistor	Radio - TV - Computer - Telephone
TV	Communication - Entertainment - News - Sports - Music

2.7 Combinations and Modifiers

* We invent when we combine existing parts or assemblies.
* We invent when we apply modifier words to an item or assembly.

* Current high speed machining spindle speed is 15,000 revs per minute.

* Current state of the art spindle speed is 40,000 revs per minute.

* The Boeing Aircraft Company asked a machine tool manufacturer to build a Hyper Machine tool with a spindle speed of 60,000 revs per minute.

* The principle modifier of the new machine tool invention is **Speed**.

Practice applying this list of modifier words to the component parts of the device you are inventing or any device that needs to be improved.

ITEM	X-MODIFIER	To	Y-MODIFIER
Components	Simple		Complex
Connection	Fixed		Pivot
Control	Manuel		Automated
Cost	Low		High
Device	Fixed		Changeable
Dimensions	Non-critical		Critical
Dimension Tolerance	Smaller		Larger
Direction	Forward / Backward		Up / Down
Elevation	Lower		Higher
Finish	Paint		Plate
Fit	Loose		Tight
Flow	Less		More
Force	Push / Pull		Linear / Rotary
Friction	Lower		Higher
Function	Single		Multiple
Height	Lower		Higher
Length	Shorter		Longer
Load	Smaller		Larger
Location	Internal		External
Magnitude	Small		Large
Material	Metal		Plastic
Motion	Linear		Rotary
Movement	Sliding		Rolling
Orientation	Horizontal		Angle
Parts	Join		Divide
Performance	Slow		Fast
Power	Manuel		Motor
Pressure	Low		High
Quality	Accept		Reject
Quantity	Less		More
Reliability	Short Term		Long Term
Shape	Flat		Curved
Side	Left / Right		Top / Bottom
Size	Smaller		Larger
Sound	Quieter		Louder
Speed	Slower		Faster
State	Stationary		Moving
Stiffness	Flexible		Rigid

Strength	Stronger		Weaker
Stress	Lower		Higher
Temperature	Lower		Higher
Time	Shorter		Longer
Torque	Lower		Higher
Weight	Lighter		Heavier
Width	Narrower		Wider

Modifier Example
Modify a cars' **size** to become larger.

Modify the **quantity** of seats to be more.

The innovation is a larger vehicle combined with more seats to become a **Mini-Bus.**

2.8 Inventor's Science

A Plaque on the wall at the National Institute of Science makes this statement:

To Science: **Pilot of industry**
Conqueror of disease
Multiplier of the harvest
Explorer of the universe
Reveler of nature's laws
Eternal guide to truth.

We tend to look to science as a source of truth about the laws of nature. The inventor applies the discoveries of science to technology. The entrepreneur brings technology to the market place.

After studying several years in a university, and graduating with bachelor, master, and doctor degrees, you will understand one small area in the field of science and technology. However, you can learn and understand all you need to know about one invention in a short time by focusing on a few relevant facts.

Most of the power developed by the automobile engine, when traveling at high speed is used to overcome wind resistance. As early as 1949 wind tunnel testing and the science of aerodynamics, was used to streamline the motor car. The car of the future will need lower aerodynamic drag in order to provide greater fuel economy. Inexpensive books and NASA reports have been published giving wind tunnel test results that can be studied and applied to new flying machines in a short time by most people.

The inventor will know or learn the science and physical laws governing the functions and parameters of a new invention. These laws are defined by equations that can be used to find unknown parameters. Some examples are given below:

Tensile Strength = Allowable Stress x Area

Shear Strength = Allowable Stress x Area / Shape Factor

Power = Force x Distance Force moves / Time

Flexibility = Applied Force / Distance Moved

Endurance = Number of Load Cycles to Failure at a Stress Level

Friction Force = Load on Surface x Coefficient of Friction

Temperature = Degrees Centigrade or Fahrenheit

Quality = Material, Allowable Dimensional Tolerances, and Surface Finish

2.9 Modify Exercise

1. Select a household or transportation item from the list below:

a. Toaster
b. Table lamp.
c. Dining table.
d. Recliner.
e. Chest of drawers.
f. Dishwasher.
g. Motor bike.
h. Car.
i. Pick-up Truck.
j. Train.
k. Airplane.
l. Any other item.

2. Think of an unsatisfied **need** that applies to the chosen item.

3. Make a simple sketch of the item and **combine** other items that will help to satisfy the needs.

4. Pick one or more **modifiers** from the list above that will change the items so they will fit and function together.

5. **Remove** unnecessary parts.

6. Add the generic name of each component on the sketch and describe the interaction between each component and mating components.

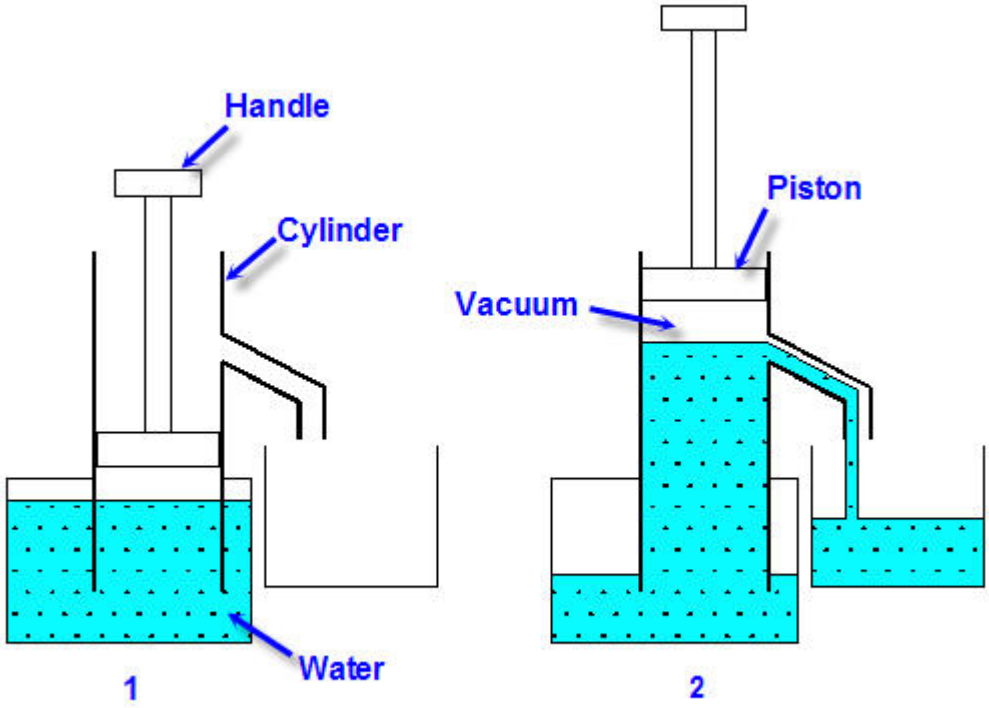
7. Add your name and today's date to your, "new to you" invention sketch.

2.10 Food Innovation

Write on a writing pad an unsatisfied FOOD need and describe with labeled sketches an innovation that will satisfy this need. Allow time: hours, days, and weeks for your subconscious computer to think of solutions.

3.0 From Pump to Gasoline engine

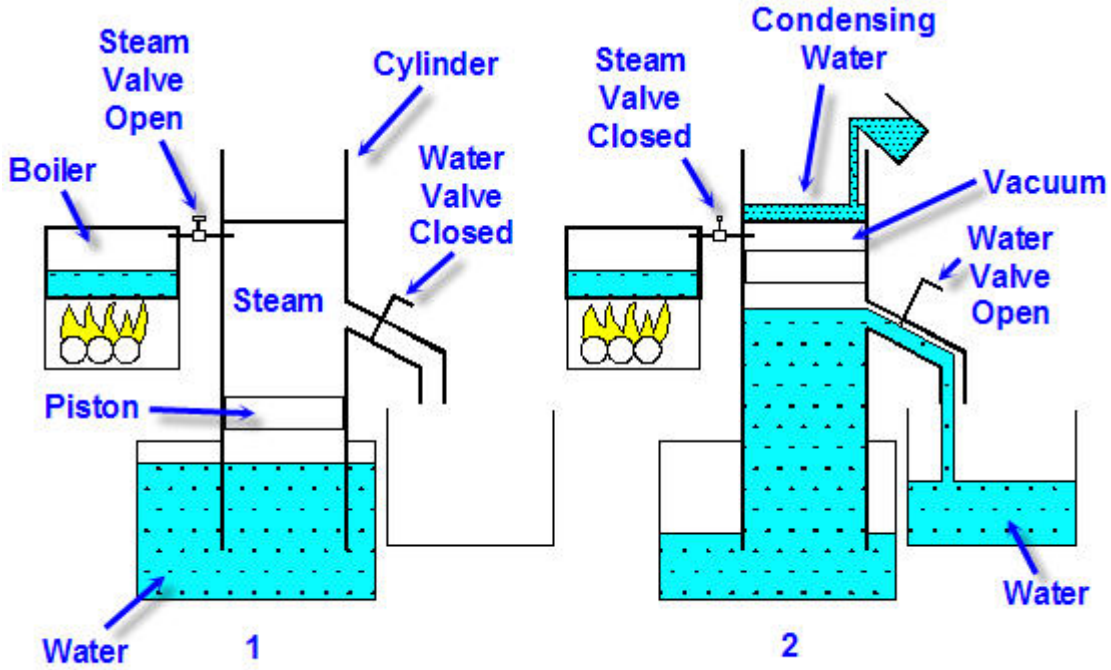
The innovation path from manual water pump to gasoline engine is described below. Existing items were combined and modified to satisfy a need in each stage of this inventing process.



Manual Water Pump

3.1 Manual Water Pump

The handle of the generic manual pump above is lifted in diagram 1 creating a vacuum below the piston. The water level rises due to atmospheric pressure with the piston in diagram 2. Eventually some of the water rises above the discharge spout and pours out.

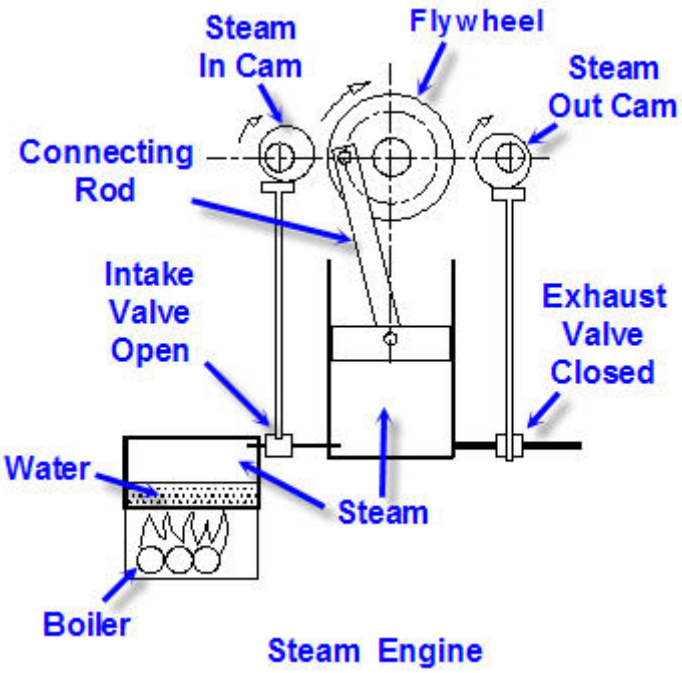


Steam Powered Water Pump

3.2 Steam Powered Water Pump

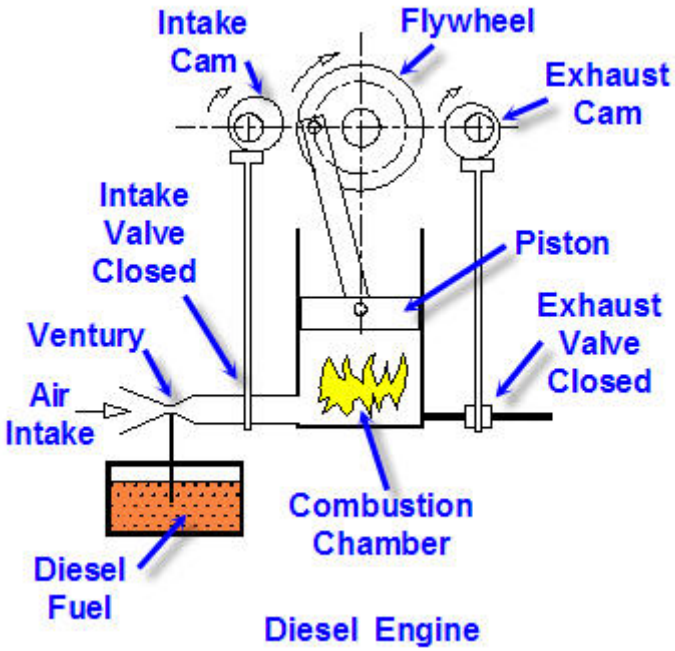
A steam powered water pump is illustrated above. Burning wood or coal fuel provided the heat energy to boil water creating pressurized steam in an external boiler. Eventually there was a need to pump huge quantities of water out of coal mines. The piston was suspended from a pivoting arm with a balance weight on the opposite end (not shown). When the valve in the pipe between the boiler and the cylinder was open in the left diagram 1, steam pressure forced the piston down to the water.

Water is lifted by the pump piston in the right of this diagram 2, when the steam valve is closed and cooling / condensing water causes the steam to condense creating a vacuum above the piston.



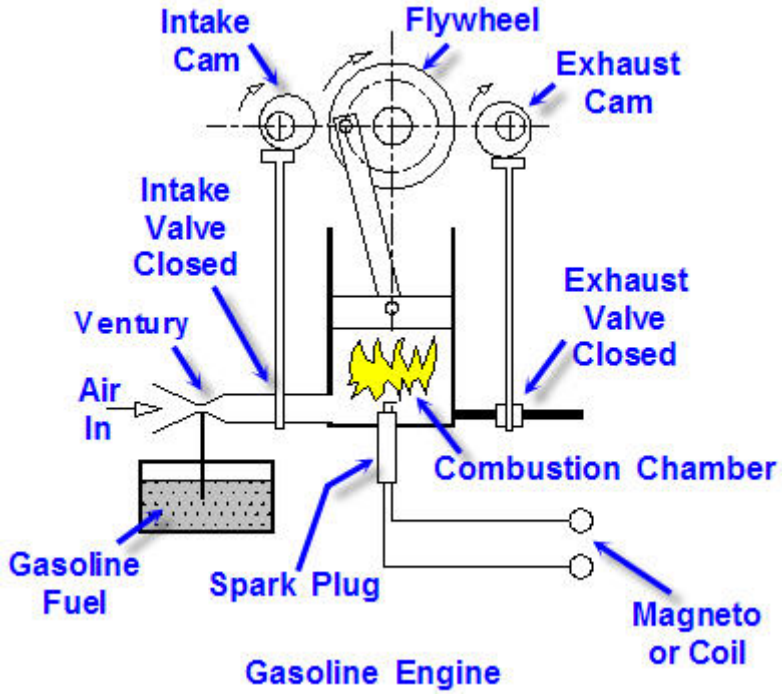
3.3 Steam Engine

The steam engine was invented by James Watt in 1800. The steam engine has the same piston in a cylinder connected by a pipe with a valve to a boiler, as the steam driven water pump. Latter on there became a need to rotate the wheels of trains and ship's propellers. **T**he connecting rod from the piston is now pivotally attached to a rotating flywheel. Cams on the flywheel shaft push valve rods up and down opening and closing the inlet and outlet valves each rotation cycle.



3.4 Diesel Engine

The diesel engine is a modified steam engine. Air and diesel vapors are drawn into the cylinder by the vacuum created by the rising piston. The rotating potential energy in the flywheel forces the piston down, compressing the air and diesel vapor. The compression is sufficient to raise the air-diesel mixture temperature to the ignition point. The exploded gas forces the piston up the cylinder which rotates the flywheel.



3.5 Gasoline Engine

The gasoline engine is a modified diesel engine. Air and gasoline vapors are drawn into the cylinder by the vacuum created by the rising piston. The rotating potential energy in the flywheel

forces the piston down, compressing the air and diesel vapor. Compressed air-gas mixture is ignited by a spark plug. The pressurized gas forces the piston up the cylinder which rotates the flywheel.

4.0 Idea to Marketplace

The inventor needs to be aware of the steps from invention idea to marketplace listed below. All stages require innovation. New products require new tools and manufacturing facilities to make them.

The optimum design alternative is chosen based on factors including: marketing projections, manufacturing equipment, personnel skill levels, quantities to be produced in a given time span, and estimated profit margin.

Bring your invention to the market place!

Step 1. Idea Conception

Use the NCMR process specified in this book to create a new and useful, apparatus or method.

Step 2. Patent Disclosure

You or your Patent Attorney should make a search of the Patent Office files at the U.S. Patent and Trademark Office web address: www.uspto.gov to see if your invention has been patented. If not, type a patent disclosure statement (see below) describing your invention and send it together with $10 to the Patent and Trademark Office to obtain 2 years of intellectual property protection and establish the date of origination and your name as the inventor.

Step 3. Patent Protection

Write a patent specification yourself (see below) or employ a patent attorney to write it. The U.S. patent examiners critique applications from private individuals and patent attorneys and grant a patent or make suggestions as to corrections needed to qualify for a patent. The Patent process can take 2 years or more.

Step 4. Prototype Drawings

Make or employ a drafts person to make assembly and detail dimensioned drawings to scale of your invention.

Step 5. Manufacture Prototypes

Send copies to local machine shops and / or industrial electrical contractors to obtain their price for manufacturing a prototype.

Step 6. Manufacturing Plan

Make a layout drawing of a factory showing the: raw materials receiving area,

workbenches, machine tool cells, aisle ways, material handling equipment, assembly-line, and finished product warehouse for producing your invention.

Step 7. Contract out Manufacturing and Sales

Obtain a contract from a manufacturing firm to produce and sell you invention.

5.0 New Wealth

We enjoy a multi-trillion dollar annual economy. Where did this enormous wealth come from? In early 1900's, a new invention called the automobile, created great wealth for the United States. When the first 15 million Model T Fords came off the assembly line in the early 1900's, there was not enough money in circulation to pay for them.

New wealth was identified on paper in the accounting books of the company.

The cars manufactured, allowed a government agency to print money, loan it to banks who, in turn, loaned it to Ford and other companies. The newly minted money paid wages to workers who used the money to buy the cars as well as other items produced.

Manufacturing companies create wealth by transforming raw materials and standard parts into new products. New service industries are created to market and maintain them. Innovations in farm machinery have reduced farm labor from 75% to less than 6% of the population.

5.1 A Small Business

A small business of 3 or 4 friends working in a garage manufacturing the new telephone invention by Alexander Bell in 1900, would buy $100 worth of raw materials. These workers would make, say 40 telephones during the following week and pay themselves a total of $200 in wages. Overhead expenses of $100 would include the lease on buildings, the cost of tools and coal for the furnace, taxes, etc. In this case the total cost to manufacture the 40 telephones in one week is $400, or $10 for each phone. These phones would be offered for sale at a price buyers were willing to pay, say $20 each. Before the first of the phones were sold, the general ledger would show a profit of 100% and a $400 increase in wealth on paper.

In this way new wealth appears in the accounting books of manufacturing companies today. As companies increase production to meet rising demand for products, they request loans from banks to purchase buildings, new equipment, and raw materials, increasing our nation's wealth further. The manufactured goods are warehoused and distributed by other companies who buy these products at wholesale prices, mark them up, and sell at higher values to retail businesses. This increases the value or wealth also. Retail shops add their profit and overhead to the wholesale price, increasing total wealth once more.

Businesses of all kinds borrow money from banks in proportion to the wealth shown on their accounting books. Banks borrow money from the Federal Reserve. They pay a low interest to the Federal Reserve. Banks receive a higher interest from loans to businesses.

As time goes on more money needs to be put into circulation to represent the new wealth created by a multitude of businesses. Each year more money needs to be printed to keep up with the increasing amount of goods sold and services provided. As a result of the expanding economy, more money is paid in wages and benefits to the workers who produced the goods.

We have a compulsion to shop for every kind of gadget that the innovators sell. We have a strong and growing economy because of all the widgets and gadgets that have been invented and manufactured and the associated services required to warehouse, sell, and maintain them. Undeveloped countries have a lower standard of living because they do not do what we do: invent new and improved products, manufacture, distribute, sell, and buy them in large quantities.

6.0 Transportation Needs

Need is the feeling that drives inventiveness. There are many needs that can be met with devices. We could walk instead of drive, but this is almost impossible for most. We rely on the automobile, powered by a gasoline engine, to get us from place to place. However, the price of gasoline, which has been rising dramatically, is controlled by foreign interests.

Each president of the United States has urged industry to innovate and develop new sources of fuel for cars and trucks.

Car Needs List:
1. Alternate energy source to gasoline.
2. Reduce operating costs.
3. Reduce pollution.
4. Increased reliability.
5. Reduce noise.

Apply the **Need + Combine + Modify + Remove** method to inventing a new family transportation vehicle. Combine a non gasoline powered engine or motor with an exiting car as outlined below:

6.1 Solar Powered Electric Motor

Advantage: Clean energy from the sun.

Disadvantage: Maximum solar energy is 1,000 Watts per square meter. A solar panel 3 feet square in direct sun light will drive a one horsepower electric motor. Four passenger cars need at least 100 horsepower. This option would require 100 solar panels, each 3 feet square.

6.2 Ethanol Fueled Engine

Advantage: Energy from renewable fuel: corn, sugar beet, other vegetation.

Disadvantages: Polluting and less energy per pound than gasoline. Increased demand drives the price of corn and other ethanol sources upward.

6.3 Battery Powered Motor

Advantages: Energy from batteries, less polluting and less noise.

Disadvantages: Batteries invented to date are heavy causing slow acceleration. Existing battery driven vehicles have limited range.

6.4 Coal Fired Steam Engine

Advantage: Energy from renewable energy source, wood, coal, and other vegetation.

Disadvantages: Slow to start from cold, requires a long warm-up period, polluting, and high maintenance.

6.5 Nuclear Heated Steam Turbine

Advantage: Long lasting energy from small fuel pellets.

Disadvantage: Radiation health hazard.

6.6. Linear Magnet Car on Rails

Advantages: Vehicles running on rails can travel at higher speeds and can be automated.

Disadvantage: High cost of rails.

6.7 Fuel Cell Motor Car

Advantages: Energy from renewable electrical energy source, hydrogen. Zero pollution. Quite electric motor power unit.

Disadvantage: High cost of hydrogen production, until a low cost method is found.

See full-size image.

arabam.milliyet.com.tr/ fuar/2003/detroit/Gene...
380 x 228 pixels - 18k
Image may be scaled down and subject to copyright.

original context on the page: **arabam.milliyet.com.tr/.../ detroit/detroit.asp**

The GM Hy-wire Fuel Cell car is pictured above and below.

Larry Burns, GM's vice president of research and development and planning, said, "We are driving to have compelling and affordable fuel cell vehicles on the road by the end of the decade.

With Hy-wire, we have taken the technology as it exists today and packaged it into an innovative drivable vehicle comparable in size and weight to today's luxury automobiles.

All of the touring sedan's propulsion and control systems are contained within an 11-inch-thick skateboard-like chassis, maximizing the interior space for five occupants and their cargo. There is no engine to see over, no pedals to operate - merely a single unit called X-drive that is easily set to either a left or right driving position."

Companies and individuals have designed and built prototypes of all the above vehicles.

Today's major automobile companies are concentrating efforts on:

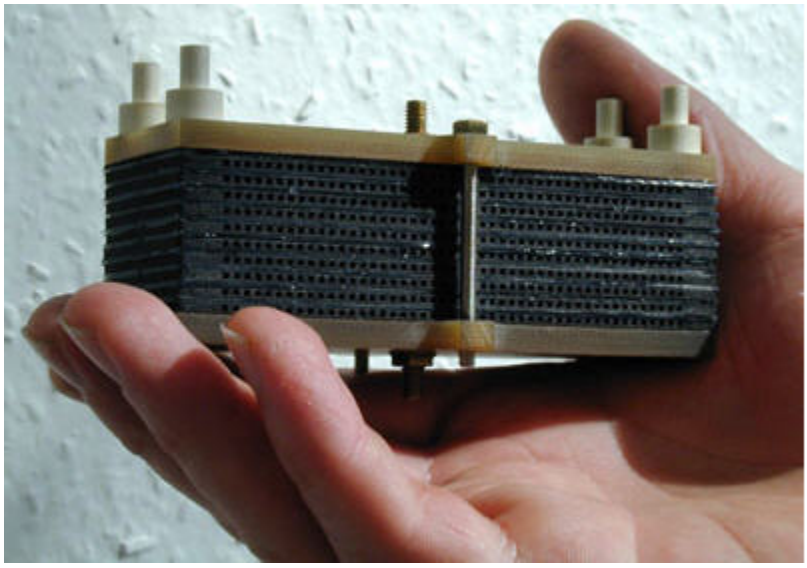
A. Fuel cell electric motor driven vehicles and
B. Hybrid battery / gasoline powered cars.

The fuel cell is the only power supply that does not require gasoline or any organic fuel.

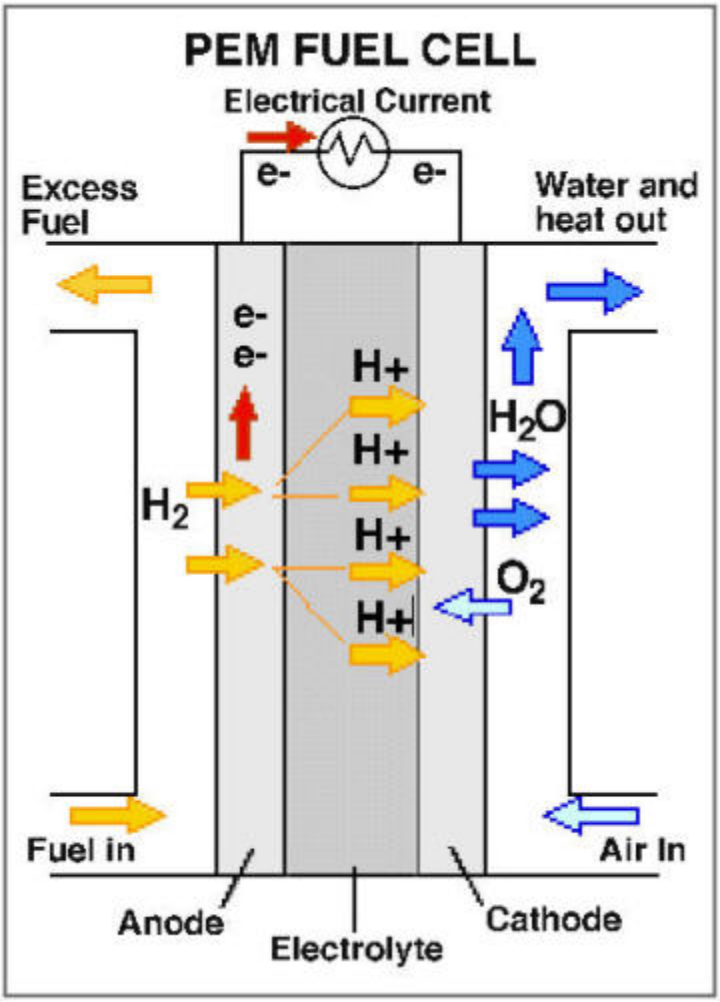
Conclusion:

Fuel Cell powered electric motor driven car is the best choice if hydrogen can be produced cost effectively. Solar, chemical, and / or nuclear energy might be able to separate hydrogen from water at a competitive price.

Fuel Cells



A fuel cell is pictured above.



The fuel cell, shown here, works like all other electric batteries. Hydrogen enters the anode on the left. An electrolyte, in the center, stops electrons and allows positively charged atoms to migrate to the cathode on the right. An electric current will drive a motor connected to the terminals of the fuel cell. The emissions from the fuel cell are steam, water, and heat. It is non-polluting.

7.0 World Energy Needs

A small area in Texas would be able to supply the total electrical energy needs for the continental United States.

See full-size image.
www.eere.energy.gov/ news/images/05_08_23_sola...
250 x 197 pixels - 22k
Image may be scaled down and subject to copyright.

original context on the page: **www.eere.energy.gov/. .../pubDate=%7Bd%20**

An array of mirrors surround the tower in the solar power installation pictured above. The mirrors focus the sun's radiant heat on the boiler surface at the top of the tower. The steam generated

drives a turbine coupled to an electrical generator. Excess electrical energy during the day is stored in batteries for nighttime supply.

7.2 Solar Power

The world wide demand for electrical power is expected to double between 2007 and 2027. The 377 million people in North America use 949 mega-watts of installed electrical power service or 2.52 kilo-watts per person. That is equivalent to a 4 horsepower engine running 24 hours a day, continuously for each man, woman, and child. Installed power service in China is much less at 0.15 kilo-watts per capita. South Asia and sub-Saharan Africa are the least with 0.09 kilo-watts per capita. (Data based on the year 2000).

Solar Energy - Renewable, Clean, and potentially Low Cost

Most countries have enough solar energy to meet their heating, cooling, and power needs. A pilot solar electric generating plant has been invented, built, and operated in the United States. Many mirrors, each mounted on computer controlled gimbals, track the sun as it moves across the sky and focus the heat radiation onto a steam turbine system that powers an electricity generator. Unfortunately the engineering and equipment proved to be too expensive. The cost of electricity from this system would not be competitive with existing systems.

There is an urgent need for someone to invent

and develop a low cost domestic solar energy system.

8.0 Innovating Professions

We are seeing continuing change and improvement in the works of the professions:

Inventor	Innovation
Architect	Buildings
Artist	Paintings / Sculptures
Author	Books
Banker	Monitory Services
Chef	Recipes
Chemist	Chemicals
Engineer	Buildings, Bridges, Machines, & Electronics
Entrepreneur	Businesses
Factory Manager	Production Systems.
Farmer	Growing Systems
Lawyer	Legal Advocacy
Mathematician	Formulas
Musician	Music / Songs
Photographer	Still and Motion Pictures
Psychologist	Mental Therapies
Physicist	Theories of the Universe
Poet	Poems

Politician.....Social Systems
Physician.....Physical Therapies
Pharmacist.....Medications
Tailors.....Clothing

8.1 Art, Music, and Literature

The NCMR method is applicable to creativity in; art, music, and literature.

Picasso's "Girl Before a Mirror" combines the face front with the face side. In art as in engineering, items, forms, and colors are combined.

Musicians combine words and musical notes and modify their arrangements to invent new songs.

Authors combine people, places, and things in literature and modify events to meet the need to inform and entertain.

9.0 Housing Innovation

Write on additional sheets, an unsatisfied need in the art, music, an literature areas and describe an innovation that will satisfy this need. Allow time: hours, days, and weeks for your subconscious computer to think of solutions.

10.0 Future Innovations

The world needs the following inventions:

Better mobility aids for the disabled

Bobbin-less sewing machine

Phone Implants

Cell phones that read text messages

Computers that speak

Cost effective solar energy

Fuel cell powered cars

Light weight battery to power cars

Lower cost everything

Domestic robot butler with vision

Monitory system that accommodates new wealth

More effective food quality testing systems

Personal vehicle traveling on land, sea, and air

Recycle everything

Self cleaning home and cars

Sensible toxic waste disposal

Smart house

Smarter air-bag

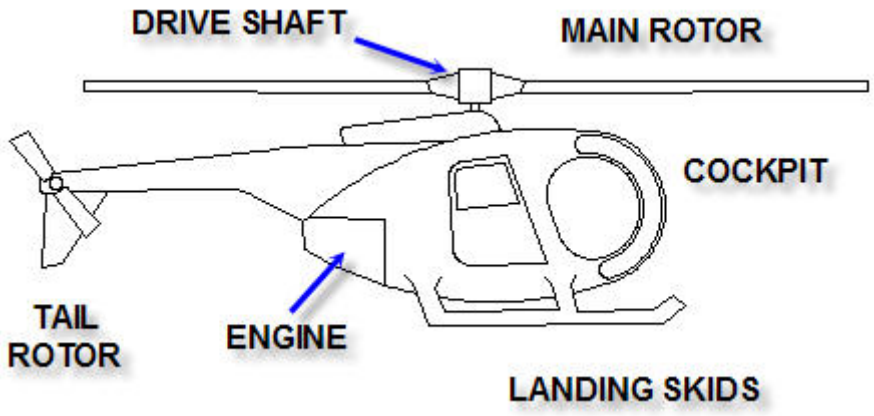
Teeth whitener for general use

11.0 Clothing Innovation

On a writing pad describe an unsatisfied need in the clothing area with labeled sketches and an innovation that will satisfy the need. Allow time: hours, days, and weeks for your subconscious computer to think of solutions.

12.0 Car-Copter

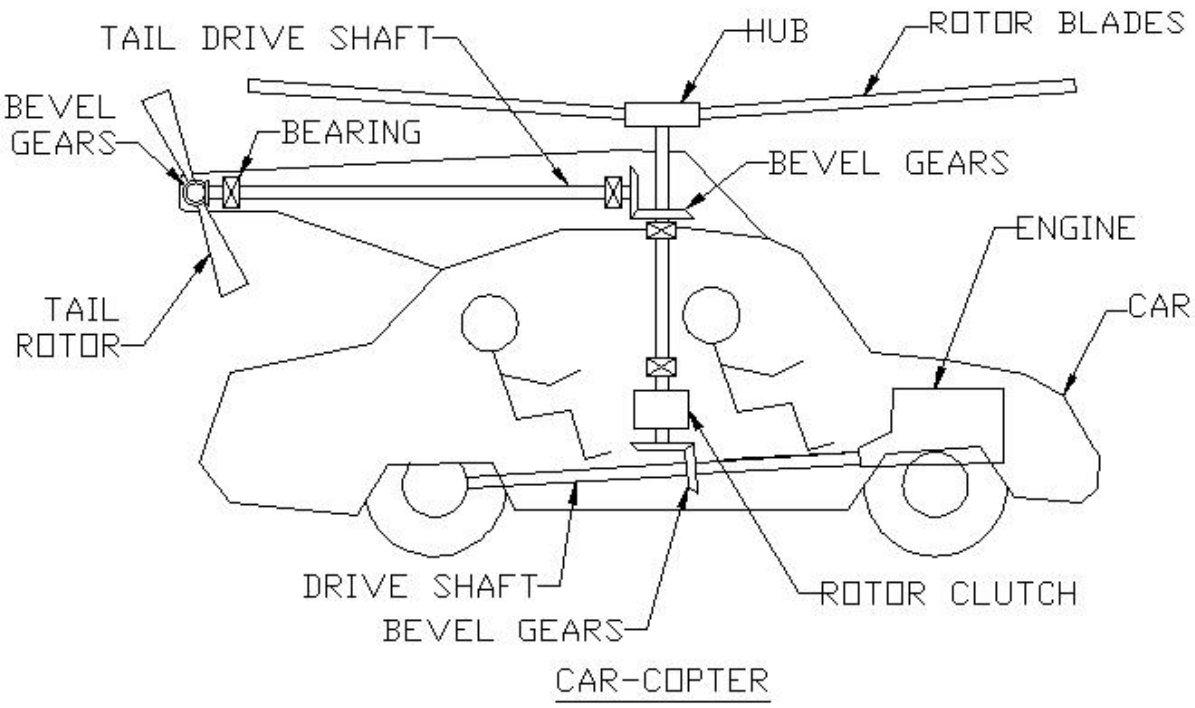
If the helicopter below can be combined with an automobile the resulting invention will be a Car-Copter that can drive on roads and fly vertically and horizontally where there are no roads.



12.1 Think Boxes

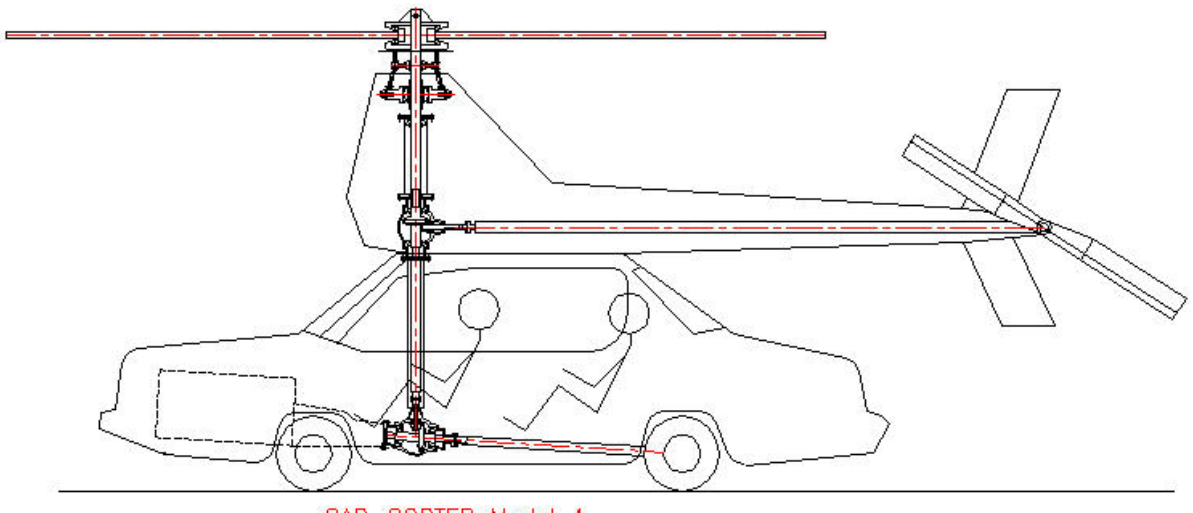
We have a natural tendency to put things into categories or boxes. The first sewing machine patents tried to duplicate hand stitching and they all failed. Singer and others invented successful sewing machines when they reversed the needle. The thread passed through the hole at the pointed end of the needle. A bobbin passed through the loop formed under the cloth as the needle rose up above the material.

* There is a car box and an airplane box.
* After practicing the NCMR method, we begin to think outside of these boxes.
* We see a need to drive where there are roads and fly where ground travel is not possible.
* The innovator combines a car with a helicopter, modifies them to fit, form, and function together, and removes non-essential parts to invent the, “Car-Copter”.



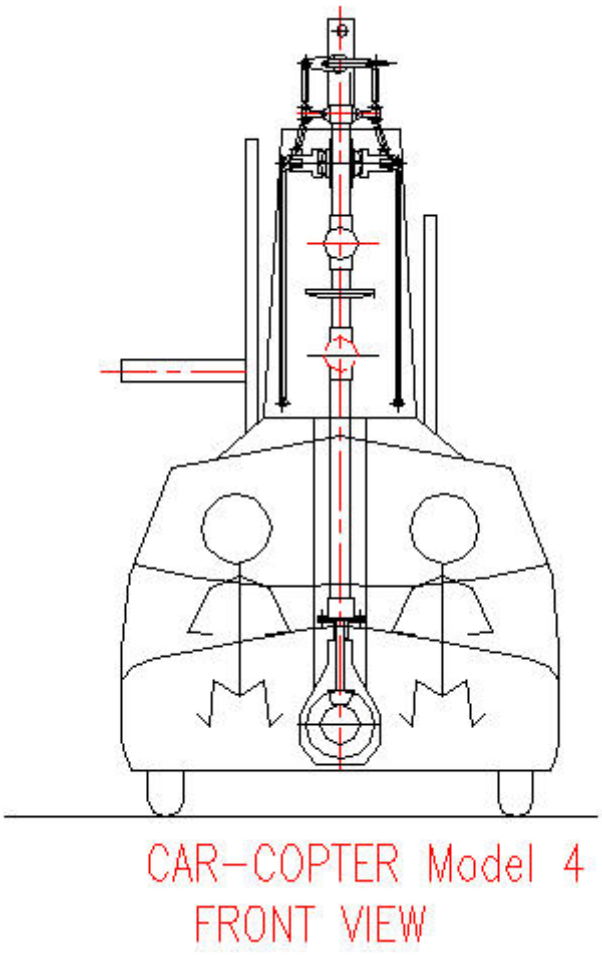
12.2 Labeled Sketch Defines Idea

The simple sketch shown above illustrates all of the essential items in a very complex invention. A vertical rotor shaft is driven by the existing automobile drive shaft. A clutch disengages the rotor shaft for travel on roads. Both main and tail rotors are hinged for folding into the tail rotor housing. The tail rotor drive shaft gear engages the main rotor shaft gear.

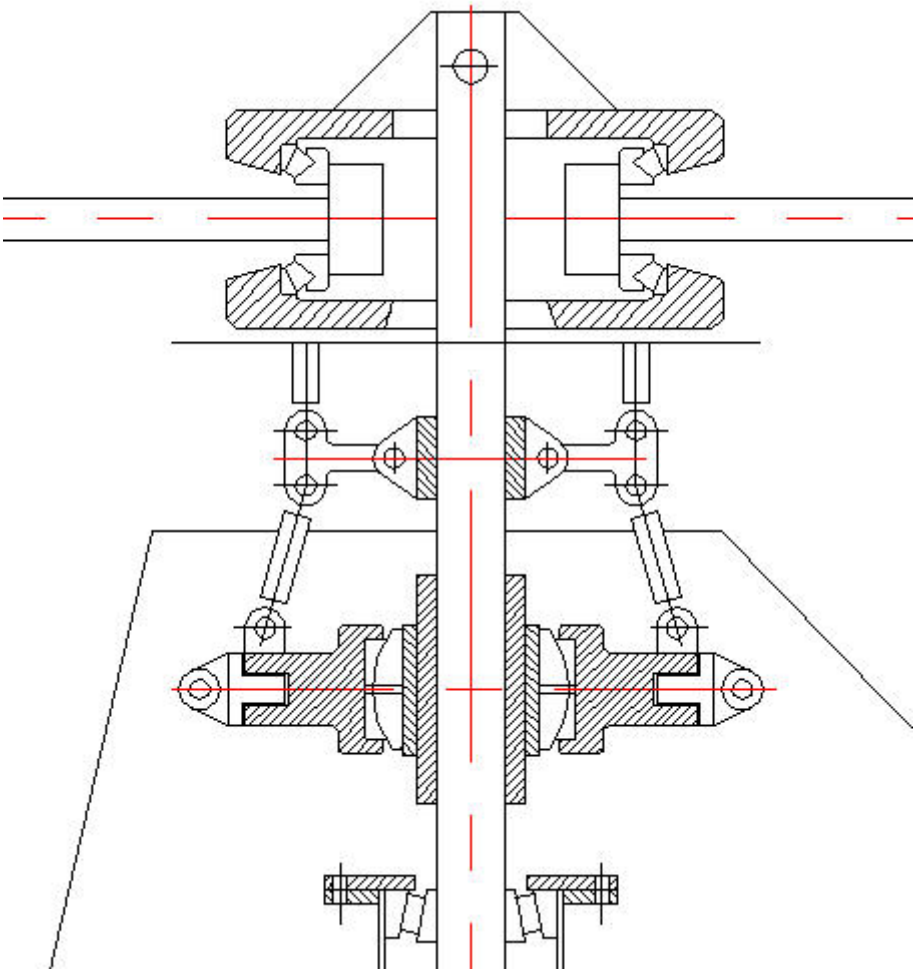


12.3 CAD Drawings Enable Manufacture

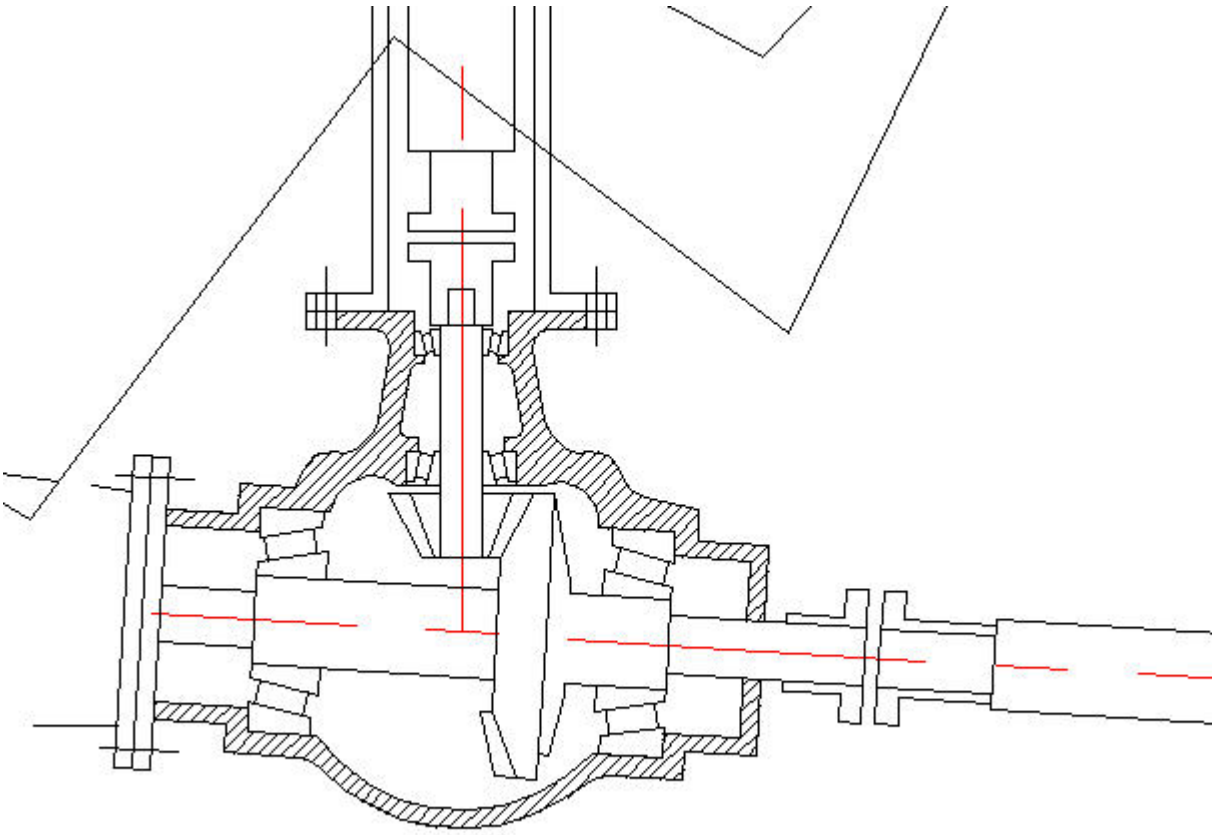
A scale side view assembly drawing of the Car-Copter is shown above. This top assembly drawing was created with AutoCAD based on the initial concept sketch above. Dimensioned drawings of every part in the assembly will be used to manufacture this invention. All computer aided drawings in this book were made with AutoCAD.



A scale front view assembly drawing of the Car-Copter was projected from the side view. Subassemblies were copied from these side and front, top assembly drawings.



The main rotor sub-assembly drawing is shown above. Detail dimensioned part drawings will be copied from this and other subassembly drawings shown below.



The main copter rotor blades are driven by the car drive shaft sub-assembly drawing is shown above. Detail dimensioned part drawings will be copied from this drawing also.

13.0 Transportation Innovation

Write on additional sheets, an unsatisfied need in the area of transportation and describe with labeled sketches an innovation that will satisfy this need. Allow time: hours, days, and weeks for your subconscious computer to think of solutions.

14.0 Great Inventors

There are many lessons to be learned from successful inventors. A brief summary is given here:

14.1 Thomas Edison

Thomas Edison patented 1,093 inventions including:

*** Electrical Power Distribution,**

*** Motion Pictures,**

*** Recorded Music,**

*** Light Bulb.**

These innovations have grown into multi-billion dollar industries today.

<u>However the world's greatest inventor, Edison, did not know how he invented.</u>

He wrote in his diary one Valentines Day, “My wife Mary, dearly beloved, doesn’t know how to invent worth a dam!” If he knew how he invented, he would have been able to teach his wife. His strong sense of people’s needs drove him to invent. He stated, “I want to see a phonograph in every American home”. He wanted everyone to be able to enjoy listening to music.

14.2 Edison’s Business Method

The first light bulb Edison invented, required high electrical current because it had low resistance, about 2 Ohms. This meant high cost large diameter copper wires over long distances.

See full-size image.
www.ieee-virtual-museum.org/. ../Y9pqVm6tdZqV.jpg
179 x 340 pixels - 9k
Image may be scaled down and subject to copyright.

original context on the page: **www.ieee-virtual-museum.org/ exhibit/exhibit.p...**

Edison allowed cost to direct inventing.

A high resistance light bulb would illuminate connected to low cost, small diameter wire. Hundreds of hours were devoted to testing different materials for the filament in the light bulb before one with high resistance and long life was found. A high resistance light bulb would illuminate connected to low cost, small diameter wire. Edison and his three faithful associates, succeeded in making a 100 Ohm bulb that would burn for many hours and that could be manufactured and sold at a profit. Thomas Edison became a multimillionaire because he owned and managed the manufacture of the light bulb.

Manufacturing generates far more income than inventing alone.

In 1885, Edison was the only person in the world capable of calculating the cost of electric lighting, a fraction of one penny per hour.

He announced that he could illuminate a large area of Manhattan with electric lighting in a newspaper. The Westinghouse Company had paid him large sums of money for his telegraph patents. He used these funds to manufacture: dynamos, switches, fuses, light bulbs, and all equipment required for the worlds first electrical power and light, distribution system.

By 1915 Edison had 3,600 workers in his factories manufacturing 30 different products with $25 million in annual sales in the USA and Europe.

14.3 Edison’s Team

Three men worked long hours for many years with Edison. Christopher Bachelor converted Edison’s sketches into patent and working drawings. John Cruzy made working models. Edward Johnson wrote patent applications, payrolls, and contracts. The US Patent Office (www.uspto.gov) honors Edison by using a light bulb as their logo.

14.4 Edison’s Inventing Method-1

Edison’s journal for 1872 has 100 sketches which developed into 34 patents.

He wrote in his notes, “The first thing I knew, the very idea I wanted would come to me”.

*** Edison did not know how he invented.**

*** I believe that most innovators do not understand the creativity process.**

14.5 The Subconscious Mind

Your subconscious mind works day and night to solve your most urgent problems. You open the door of your car and suddenly the answer to a financial problem comes to you, "out-of-the-blue-sky". Your conscious mind was concerned with the immediate need to get to work on time while the subconscious found a solution to a long term need.

We should allow our subconscious mind time to process things that concern us.

The answer to a design problem will come to us when we least expect it.

14.6 Edison's Inventing Method-2

If Edison could not solve a complicated invention problem, he would sketch a parallel device or build a model. His quadruplex invention is an example. There was a need to transmit 2 telegraph messages from station A to B at the same time 2 other messages were being sent from B to A on the same wire. Edison built a model of tubes and valves that would allow pumped fluids to represent electrical telegraph signals.

He solved a complex problem in uncharted territory by making a model of a simpler known process.

14.7 Lessons Past Inventors Teach

Consider what Inventors from the past have done to improve the economy and quality of life. What can we learn from them?

14.8 Johann Gutenberg - Printing Press

Observed wood blocks were used to transfer designs to paper.

Learned how to cast metal in the Mint.

Modified wood blocks to become cast metal type.

14.9 James Watt - Steam Engine

Combined Newcommen's steam pump with a flywheel, connecting rod and cam operated valves to become the first steam engine.

14.10 Henry Ford - Low Cost Car

Divided the manufacture of the automobile into hundreds of small operations that could be performed on an assembly line by unskilled labor.

14.11 Wilbur and Orville Wright - Airplane

Combined the glider with an engine to become the first airplane.

14.12 Leonardo de Vinci - Inventor / Artist / Scientist

Modified small weapons to become large war machines.

14.13 Alexander Graham Bell - Telephone

Modified telegraph transmitter to become telephone.

14.14 George W. Carver - Chemicals / Printers Ink / Soap / Varnishes

Combined and Modified peanuts to become 325 different chemicals.

14.15 Louis Daguerre - Camera

Accidentally spilled mercury onto a silver plate with silver iodide to become the first photograph.

14.16 Guglielmo Marconi - Radio

Combined an electric coil invented by Hertz with a condenser and an instrument for detecting electromagnetic waves called a coherer which became the first wireless transmitter and receiver. Think of how many things operate by wireless transmissions. This invention led the way to: television, internet, cell phones, remote car door un-locker, etc.

14.17 Charles Babbage - Calculator

Combined machine with gears and punched cards to do mathematical calculations and store the information.

15.0 Your Subconscious Computer

1. If you cannot answer a question or solve a problem, give yourself time to think about it. Some people give up trying instantly if they don't know the answer.
2. Concentrate more on asking questions than on finding answers. Good questions produce benefits, poor questions do not.
3. Jot down your most compelling needs and look at them morning and night. Your subconscious mind works 24 / 7 searching and finding solutions to those things that concern you most.
4. This is where ideas come from, often when least expected. You open the door of your car and the answer to a financial problem comes to you. That is how many inventions came to Edison and to many others.
5. The subconscious mind is a vast library of valuable information. Almost everything you have seen and heard is stored there in categories. There is a place for music, motor skills, and every other talent and experience.

Reference, "Think and Grow Rich" by Napoleon Hill.

15.1Innovation Blockers

1. Satisfaction: Being satisfied with the way things are.

Answer: Technology has improved the quality of life for many.

2. Dissatisfaction: Being afraid of change and disappointed with the stress of modern living.

Answer: The, "Good old days" of medical treatment were barbaric.

It has been said that persistence is stronger than education and money.

3. Failure: The fear failure prevents progress.

Answer: Study the NCMR method within this document and give yourself time to think of new ideas and improvements.

16.0 Need for Research

Research and development must continue in all areas of human endeavor in order to improve the quality of life for as many as possible. **We don't know everything about anything.**

16.1 Education

Consider the vast amount of research and development that has gone into the form and function of the various elastomers:

rubber tires	**adhesives**
latex gloves	**sealing compounds**
flexible hose	**vibration dampers**

The governor of Michigan has appropriated funds for a $4.6 million National Elastomer Center for undergraduate technical training for even more research and development. Surly we know everything about the science and manufacturing of elastomers don't we? No. This is one example in the field of education that demonstrates why the innovator is so vital to any society.

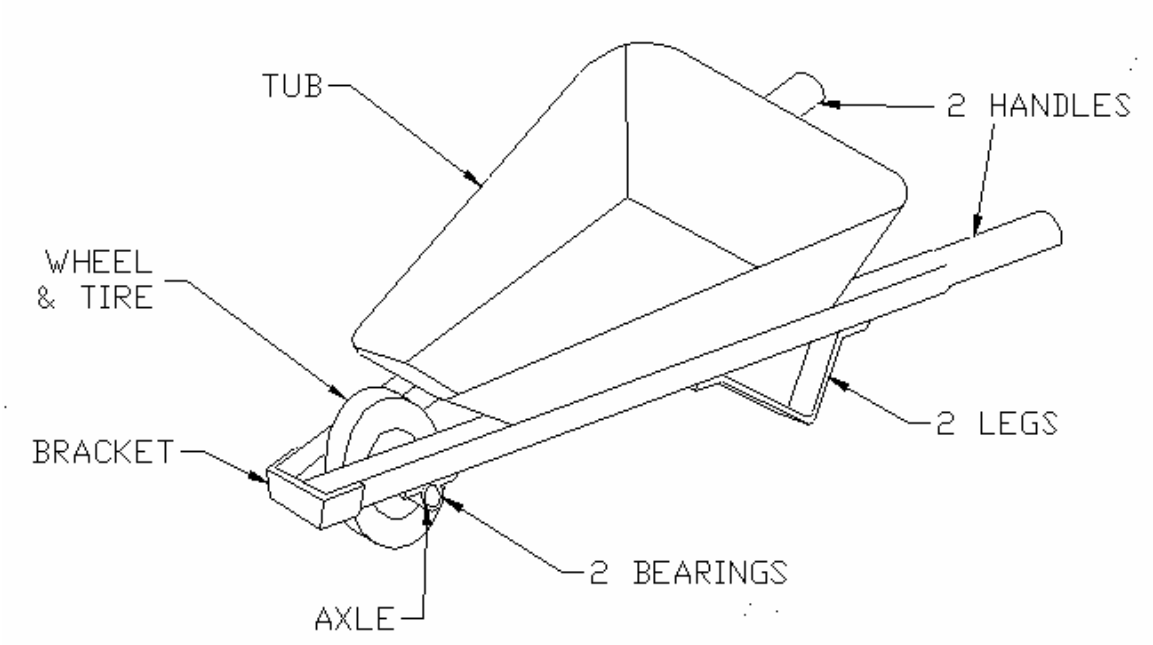
16.2 Industry

Consider the numbers of Inventors whose efforts produced over 5,000 new computer related products displayed at the annual Comdex Exposition in Las Vegas. One company that manufactures conveyors is adding a 200,000 sq ft research and technology center this year. If this effort to facilitate innovation is being applied to conveyors, we can be reasonably certain that similar efforts are applied to advance and improve many other products.

17.0 Wheelbarrow Project

When the wheelbarrow was invented, production doubled.

One person could do the work previously done by two.



17.1 Needs Satisfied by the Wheelbarrow

1. **Carry material to be moved.**
2. **Dump material at chosen locations.**
3. **Contain materials to be mixed such as cement, sand, and water.**

17.2 Needs Not Satisfied by the Wheelbarrow

A. Move loads without lifting them.

B. Provide a place to sit.

C. A cover.

D. Tip over stability.

E. Collapsible.

F. Convenient storage.

17.3 A Better Wheelbarrow

Make a simple sketch of a, new to you, wheelbarrow invention by:

Combining: One or more wheels to increase stability of the wheelbarrow.

A larger rectangular tub.

Removing: The existing tub.

Modifying: Combine the new parts to fit together.

Make a simple sketch in the space provided here: Combining existing items, Modifying them to fit, form, and function together, and Remove unnecessary items so that some or all of the above Needs are satisfied.

Each component in a freehand sketch of new invention idea should be labeled.

18.0 Invention List

Printing Press	1440	Gutenberg	Gas mantle	1885	Weisbach
Barometer	1643	Torricelli	Camera, Kodak	1888	Eastman
Air Pump	1650	Guericke	Acetylene gas	1892	Wilson
Clock, pendulum	1657	Huygens	Automobile, electric	1892	Morrison
Balloon	1763	Montgolfier	Automobile, gasoline	1892	Duryea
Bifocal lens	1780	Franklin	Diesel engine	1895	Diesel
Gas lighting	1792	Murdoch	X-Ray	1895	Roentegen
Cotton gin	1793	Whitney	Magneto	1895	Bosch
Electric battery	1800	Volta	Telephone	1900	Bell
Steam engine	1800	Watt	Airplane	1903	Wright Brothers
Gun, breechloader	1811	Thornton	Bakelite	1907	Baekland
Calculating machine	1823	Babbage	Radio	1907	Marconi
Electromagnet	1824	Sturgen	Glass, safety	1909	Benedictus
Sulfuric acid	1831	Phillips	Light bulb	1910	Edison
Elevator brake	1852	Otis	Phonograph	1910	Edison
Glider	1853	Cayley	Air conditioner	1911	Carrier
Gas burner	1855	Bunsen	Auto Self starter	1911	Kettering
Flat iron, electric	1862	Seely	Cellophane	1911	Brandenberger
Dynamite	1866	Nobel	Geiger counter	1913	Geiger
Air brake	1868	Westinghouse	Filament, tungsten	1915	Langmuir

Celluloid	1870	Hatt	Gun, Browning	1916	Browning
Engine, gasoline	1872	Brayton	Elevator	1922	Larson
Carburetor	1873	Daimler	Gasoline, lead ethyl	1922	Midgley
Rail car coupler	1873	Janney	Circuit breaker	1925	Hilliard
Carpet sweeper	1876	Bissell	Gasoline, high octane	1930	Ipatieff
Cathode ray tube	1878	Crookes	Computer	1939	Aiken
Cultivator, disc	1878	Mallon	Aerosol spray	1941	Goodhue
Cash register	1879	Ritty	Camera, Polaroid	1948	Land
Engine, automobile	1879	Benz	Laser	1958	Townes
Cream separator	1880	DeLaval			
Electric fan	1882	Wheeler			
Bicycle	1884	Starly			
Paper, sulfite process	1884	Dahl			
Adding machine	1885	Burroughs			

This is the end of, “HOW TO INVENT BY THE NVMR METHOD”.