MECHANICAL ENGINEERING

APRIL'21

PECMEC'21

DEPARTMENT ACTIVITIES . . .

STUDENT'S ACHIEVEMENTS . . .

ARTICLES . . .

PECMEC'21

MECHANICAL ENGINEERING

PANIMALAR ENGINEERING COLLEGE

(A CHRISTIAN MINORITY INSTITUTION)

JAISAKTHI EDUCATIONAL TRUST

ACCREDITED BY NATIONAL BOARD OF ACCREDITATION (NBA)

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**The magazine PECMEC'21 is a testament of the Department of Mechanical Engineering's success.
We would like to extend our heartfelt compliments to the editorial team for their tremendous work and commitment in preparing the magazine.**

I am quite delighted to convey that the Mechanical Engineering Department produces competent and innovative members of society.

**Imagination is more important than knowledge,
Einstein famously observed, "Logic will get you from A to B, But imagination will take you everywhere."**

Develop your imagination!

Dr.C.SAKTHIKUMAR,M.E.Ph.D,
DIRECTOR

PECMEC'21 displays the exceptional level of achievement achieved by the students in this year's class. In order to draw out the latent talents and abilities of students, as well as to provide a forum for them to demonstrate their literary abilities, the college magazine has been created.

I'd want to express my heartfelt gratitude to each and every one of the authors of the works published in this magazine for their hard work and dedication. A key factor in making this publication feasible has been the willingness of people to share their knowledge with their fellow beings, as well as their concerns and unique thoughts with them.

VISION

The Department of Mechanical Engineering will be globally recognized as a pioneer in Under Graduate Engineering Programs through its excellence in teaching and research, catering to the significant and evolving societal needs.

MISSION

Mission 1:To serve the society by developing competent engineers with outstanding leadership qualities and ethical values.
Mission 2:To address the progressive needs of the society and industry using modern engineering tools and cutting edge technologies.
Mission 3:To inculcate the importance of professional development within budding engineers through sustained learning.

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

PEO 1:Graduates will contribute to the industrial and societal needs as per the recent developments using knowledge acquired through basic engineering education and training.
PEO 2:Graduates will be able to demonstrate technical knowledge and skills in their career with systems perspective, analyze, design, develop, optimize, and implement complex mechanical systems.
PEO 3:Graduates will be able to work in multidisciplinary environment developing complex mechanical systems.
PEO 4:Graduates will work as a team or as an individual with utmost commitment towards the completion of assigned task using apt communication, technical and management skills.
PEO 5:Graduate will recognize the importance of professional development by pursuing higher studies in various specializations.

PROGRAM SPECIFIC OUTCOMES (PSOs)

PSO1: Fundamental Domain Knowledge: Design mechanical systems in various fields of machine elements, thermal, manufacturing, industrial and inter disciplinary fields using engineering/technological tools.

PSO2: Usage of software programs: Resolve new challenges in Mechanical Engineering using modern computer tools and software programs.

PSO3: Continual learning and Research: Develop intellectual and technical solution to complex mechanical problems through continual learning and research.

3D PRINTED HOUSE

- M.CARL AARON
(III Mech)

I n Larry Sass's vision of the future, new buildings will rise faster, use fewer resources, cost less, and be more delightful to the eye than ever before. This transformation will be made possible through digital fabrication, a new delivery system for buildings that will enable architects to send computer-designed plans directly to manufacturing – perhaps soon to be 3-D printed.

"There's a lot of research on the design and organization of cities and how cities should develop over time. But there is almost no research on how to manufacture and make the buildings you design," says Sass, who does exactly such research as an associate professor of architecture and director of MIT's Digital Design Fabrication Group.

Building construction essentially hasn't changed since the 1800s; it remains slow, labor-intensive, and costly. Digital fabrication offers a streamlined process in which a computer-designed building can be manufactured as a sequence of precision-cut, interlocking parts that can be pieced together on site like a giant jigsaw puzzle, saving on parts and labor.

"It's the right delivery system for the developing world, because the developing world doesn't have an infrastructure of tools, air guns, saws, and power," Sass says. Startup costs are also low since computer numerical control (CNC) machines are inexpensive and portable. "Design and highquality construction is mostly for the rich," says Sass, who was raised in Harlem. "I've always wanted to figure out how to bring design choice and architectural delight to the poor."

Digital fabrication relies on three technologies developed at MIT: CNC, invented in the 1950s to enable computers to control machines; computeraided design software, created in the 1960s for drawing structures; and 3-D printing, a process that emerged in the 1980s for making solid models from digital designs. Combining these techniques enables designs to be tested accurately through rapid prototyping; the computer-drawn plans are so precise that any building that functions in prototype is guaranteed to scale up successfully.

"The Industrial Age was all about making identical copies of one design. The Information Age is about the simple manufacturing of infinite design possibilities through the application of a finite set of rules for manufacturing," Sass says. "The challenge is figuring how to write new software that allows you to decompose very large designs into thousands of small parts for manufacturing.

As a proof of concept, Sass built a digitally fabricated house for an exhibit at the Museum of Modern Art in New York in 2008. Prototyped at MIT at 1/6 scale, the full-size "printed house" was a complete success, taking just days to hammer together all 5,200 pieces.

Now Sass is developing ways to digitally reproduce objects directly from photographs in the hopes of speeding up the reconstruction needed after storms and other disasters. "You take photos of a house, run them through some software, and the machine makes all the components of the house that was just lost," he says. "Imagine. Using photos and large-scale 3-D printing, you could reconstruct someone's house in about six days.

DESIGN

Architect James Bruce Gardiner pioneered architectural design for Construction 3D Printing with two projects. The first Freefab Tower 2004 and the second Villa Roccia 2009–2010. FreeFAB Tower was based on the original concept to combine a hybrid form of construction 3D printing with modular construction. This was the first architectural design for a building focused on the use of Construction 3D Printing. Influences can be seen in various designs used by Winsun, including articles on the Winsun's original press release and office of the future. The FreeFAB Tower project also depicts the first speculative use of multi-axis robotic arms in construction 3D printing, the use of such machines within construction has grown steadily in recent years with projects by MX3D and Branch Technology.

3D concrete printing technology is used in the construction of thin-walled wall structures that do not require thermal insulation conditions. The corrugated surface of such wall systems is a facing, has a decorative function on both sides, which increases its value.

The unified wall elements are produced in the workshop by a Concrete Flow portal printer with a double extruder that prints two elements at the same time. Rupert Soar described this way of useful application of technology in the article "Beyond prefabrication - the potential of next generation technologies to make a step change in construction manufacturing"

Construction Speed

Claims have been made by Behrokh Khoshnevis since 2006 for 3D printing a house in a day, with further claims to notionally complete the building in approximately 20 hours of "printer" time. By January 2013, working versions of 3D-printing building technology were printing 2 metres (6 ft 7 in) of building material per hour, with a follow-on generation of printers proposed to be capable of 3.5 metres (11 ft) per hour, sufficient to complete a building in a week.

The Chinese company WinSun has built several houses using large 3D printers using a mixture of quick drying cement and recycled raw materials. Ten demonstration houses were said by Winsun to have been built in 24 hours, each costing US $5000 (structure not including, footings, services, doors/windows and fit out). However, construction 3D printing pioneer Dr. Behrokh Khoshnevis claims this was faked and that WinSun stole his intellectual property.

DIGITAL MANUFACTURING

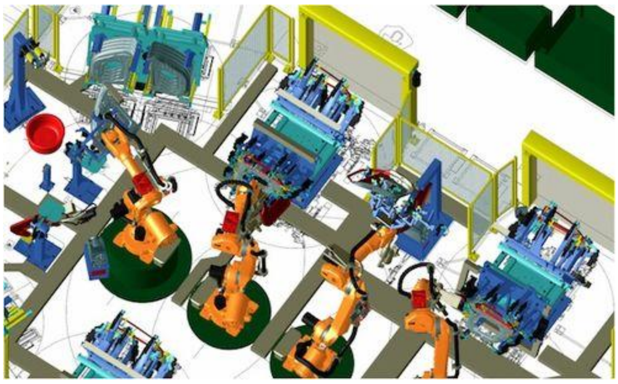
-R.K.CHERIN

(III Mech)

Digital manufacturing is an integrated approach to manufacturing that is centered around a computer system The transition to digital manufacturing has become more popular with the rise in the quantity and quality of computer systems in manufacturing plants. As more automated tools have become used in manufacturing plants it has become necessary to model, simulate, and analyze all of the machines, tooling, and input materials in order to optimize the manufacturing process. Overall, digital manufacturing can be seen sharing the same goals as computer-integrated manufacturing (CIM), flexible manufacturing, lean manufacturing, and design for manufacturability (DFM). The main difference is that digital manufacturing was evolved for use in the computerized world.

3D MODELING

Manufacturing engineers use 3D modeling software to design the tools and machinery necessary for their intended applications. The software allows them to design the factory floor layout and the production flow. This technique lets engineers analyze the current manufacturing processes and allows them to search for ways to increase efficiency in production before production even begins.



SIMULATION

Simulation can be used to model and test a system's behavior. Simulation also provides engineers with a tool for inexpensive, fast, and secure analysis to test how changes in a system can affect the performance of that system.

These models can be classified into the following:

- Static - System of equations at a point in time
- Dynamic - System of equations that incorporate time as a variable
- Continuous - Dynamic model where time passes linearly
- Discrete - Dynamic model where time is separated into chunks
- Deterministic - Models where a unique solution is generated per a given input

- Stochastic - Models where a solution is generated utilizing probabilistic parameters

Applications of simulation can be assigned to:

- Product design (e.g. virtual reality)
- Process design (e.g. assisting in the design of manufacturing processes)
- Enterprise resource planning

ANALYSIS

Digital manufacturing systems often incorporate optimization capabilities to reduce time, cost, and improve the efficiency of most processes. These systems improve optimization of floor schedules, production planning, and decision making. The system analyzes feedback from production, such as deviations or problems in the manufacturing system, and generates solutions for handling them.

TOOLING AND PROCESSES

There are many different tooling processes that digital manufacturing utilizes. However, every digital manufacturing process involves the use of computerized numerical controlled machines (CNC). This technology is crucial in digital manufacturing as it not only enables mass production and flexibility, but it also provides a link between a CAD model and production. The two primary categories of CNC tooling are additive and subtractive. Major strides in additive manufacturing have come about recently and are at the forefront of digital manufacturing. These processes allow machines to address every element of a part no matter the complexity of its shape.

BENEFITS

- Optimization of a parts manufacturing process. This can be done by modifying and/or creating procedures within a virtual and controlled environment. By doing this the use of new robotic or automated systems can be tested in the manufacturing procedure before being physically implemented.
- Digital manufacturing allows for the whole manufacturing process to be created virtually before it is

implemented physically. This enables designers to see the results of their process before investing time and money into creating the physical plant.

- The effects caused by changing the machines or tooling processes can be seen in real-time. This allows for analysis information to be taken for any individual part at any desired point during the manufacturing process.

ON DEMAND

- **Additive Manufacturing -** Additive manufacturing is the "process of joining materials to make objects from 3D model data, usually layer upon layer." Digital Additive manufacturing is highly automated which means less man hours and machine utilization, and therefore reduced cost.
- **Rapid Manufacturing-** Much like Additive manufacturing, Rapid manufacturing uses digital models to rapidly produce a product that can be complicated in shape and heterogeneous in material composition. Rapid manufacturing utilizes not only the digital information process, but also the digital physical process. Digital information governs the physical process of adding material layer by layer until the product is complete. Both the information and physical processes are necessary for rapid manufacturing to be flexible in design, cheap, and efficient.

CLOUD-BASED DESIGN

Cloud-Based Design (CBD) refers to a model that incorporates social network sites, cloud computing, and other web technologies to aid in cloud design services. This type of system must be cloud computing-based, be accessible from mobile devices, and must be able to manage complex information. Autodesk Fusion 360 is an example CBD.

Cloud-Based Manufacturing (CBM) refers to a model that utilizes the access to open information from various resources to develop reconfigurable production lines to improve efficiency, reduce costs, and improve response to customer needs. A number of online manufacturing platforms enables users to upload their 3D files for DFM analysis and Manufacture.

DO-IT-YOURSELF MANUFACTURING

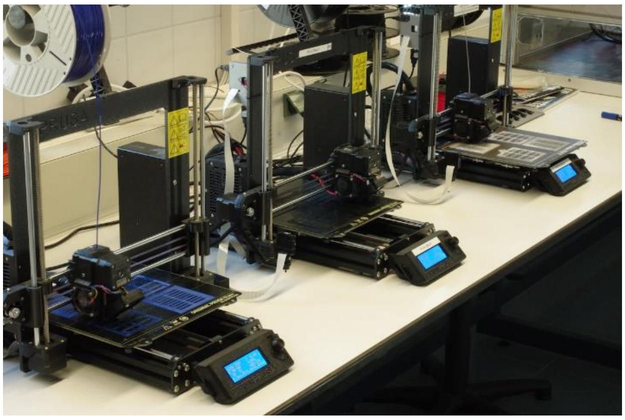
-P.AKASH
(IV Mech)

"Do it yourself" ("DIY") is the method of building, modifying, or repairing things by oneself without the direct aid of professionals or certified experts. Academic research has described DIY as behaviors where "individuals use raw and semi-raw materials and parts to produce, transform, or reconstruct material possessions, including those drawn from the natural environment (e.g., landscaping)". DIY behavior can be triggered by various motivations previously categorized as marketplace motivations (economic benefits, lack of product availability, lack of product quality, need for customization), and identity enhancement (craftsmanship, empowerment, community seeking, uniqueness).

The term "do-it-yourself" has been associated with consumers since at least 1912 primarily in the domain of home improvement and maintenance activities. The phrase "do it yourself" had come into common usage (in standard English) by the 1950s, in reference to the emergence of a trend of people undertaking home improvement and various other small craft and construction projects as both a creative-recreational and cost-saving activity.

Subsequently, the term DIY has taken on a broader meaning that covers a wide range of skill sets. DIY has been described as a "self-made-culture"; one of designing, creating, customizing and repairing items or things without any special training. DIY has grown to become a social concept with people sharing ideas, designs, techniques, methods and finished projects with one another either online or in person.

DIY can be seen as a cultural reaction in modern technological society to increasing academic and economic specialization which brings people into contact with only a tiny focus area within the larger context, positioning DIY as a venue for holistic engagement. DIY ethic is the ethic of self-sufficiency through completing tasks without the aid of a paid expert.



DIY - Manufacturing

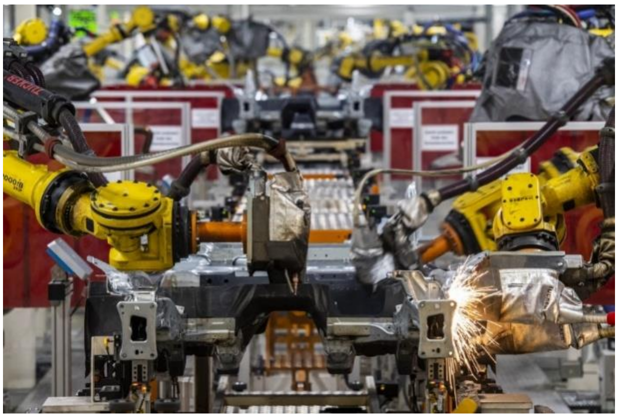
Many cities on the planet now have a workshop equipped with computer-controlled tools making things, and a growing network of such shops around the world is sparking a revolution: do-it-yourself manufacturing. These shops — dubbed fab labs and spawned at MIT — and their brethren are poised to reshape cities economically and socially. City dwellers making their own furniture, housewares, and consumer electronics is a radical departure from today's world of global brands and globe-spanning supply chains. And it's a gleaming vision of a sustainable and prosperous future that also turns the clock back centuries to a time when cities were self-sufficient and people had the means to build what they needed.

In addition to laser cutters and large-scale milling machines, fab labs also include 3-D scanners and printers, micron-scale milling machines and sign cutters, and tools for assembling electronics and programming embedded processors. These are all connected by custom software and materials. MIT's Center for Bits and Atoms (CBA) set up the first fab lab a decade ago. Since then the technology has spread virally, with several hundred operating worldwide, said Prof. Neil Gershenfeld, CBA's Director and originator of fab labs.

Do-it-yourself manufacturing is helping cities evolve by sparking local, small manufacturing businesses and teaching young people to be selfsufficient. All fab labs have the same machines and software so projects can be shared and the knowledge of how to use the labs can spread. A Fab Foundation supports the network, and a Fab Academy trains the people.

Fab labs, along with supporting cities in developing countries, have also proved vital to developed cities with significant economic challenges, like Barcelona and Detroit, and in underserved communities elsewhere, like Amsterdam and Boston. Vicente Guallart, founder of the Institute of Advanced Architecture of Catalonia, set up a fab lab in Barcelona and is now the city's chief architect. "They're filling the city with fab labs," Gershenfeld said.

Barcelona sees do-it-yourself manufacturing, along with urban agriculture and local energy production, as a way to rebuild the city's tattered economy, said Gershenfeld. "The crucial connection between digital fabrication and the future of Barcelona is technical self-sufficiency," he said. "The goal is for the city to be globally connected for knowledge but able to locally produce what it consumes."



In the past, cities were less reliant on trade and transportation networks for their citizens' basic needs. The do-it-yourself and local movements aim to reduce cities' regional and global dependencies. "It's a modern return to an older notion of a city-state," said Gershenfeld. Fab labs also contribute to cities' social sustainability. In Barcelona, where youth unemployment is 50 percent, the labs teach skills and allow people to make things to use or sell. They give at-risk youth fulfilling and engaging activities and the opportunity to develop. They're doing the same for the inner cities of North America.

The first fab lab was established at the South End Technology Center in Boston by Mel King, former MIT adjunct professor. The lab hosts the Teach to Learn, Learn to Teach program that teaches children to teach each other. A group of fab labs in Detroit run by an MIT graduate also focuses on youth. It "delivers better life outcomes than the social services that were on offer for them," said Gershenfeld.

Neither urban planners nor fab labs' developers initially considered the role do-it-yourself digital fabrication could play in the evolution of cities, said Gershenfeld. But fab labs experiences around the world have become an unexpected road map for empowering cities, he said. "That wasn't really anybody's agenda or plan, but grew naturally from the growth of the network," he said. "It's a fundamental change of the notion of civic infrastructure."

FLYING CAR

-A.BARATH

(III Mech)

A flying car or roadable aircraft is a type of vehicle which can function as both a personal car and an aircraft. As used here, this includes vehicles which drive as motorcycles when on the road. The term "flying car" is also sometimes used to include hovercars.

Many prototypes have been built since the early 20th century, using a variety of flight technologies. Most have been designed to take off and land conventionally using a runway, although VTOL projects are increasing. None has yet been built in more than a handful of numbers.

Their appearance is often predicted by futurologists, and many concept designs have been promoted. But their failure to become a practical reality has led to the catchphrase "Where's my flying car?", as a paradigm for the failure of predicted technologies to appear.

Flying cars are also a popular theme in fantasy and science fiction stories.

DESIGN

A flying car must be capable of safe and reliable operation both on public roads and in the air. For mass adoption, it will also need to be environmentally friendly, able to fly without a fully qualified pilot at the controls, and come at affordable purchase and running costs.

Design configurations vary widely, from modified road vehicles such as the AVE Mizar at one extreme to modified aircraft such as the Plane Driven PD-1 at the other. Most are dedicated flying car designs.

1. **Lift**

Like other aircraft, lift in flight is provided by a fixed wing, spinning rotor or direct powered lift. The powered helicopter rotor and direct lift both offer VTOL capability, while the fixed wing and autogyro rotor take off conventionally from a runway.

The simplest and earliest approach was to take a driveable car and attach removable flying surfaces and propeller. However when on the road, such a design must either tow its removable parts on a separate trailer or leave them behind and drive back to them before taking off again.

Other conventional takeoff fixed-wing designs, such as the Terrafugia Transition, include folding wings that the car carries with it when driven on the road.

Vertical takeoff and landing (VTOL) is attractive, as it avoids the need for a runway and greatly increases operational flexibility. Typical designs include rotorcraft and ducted fan powered lift configurations. Most design concepts have inherent problems.

Rotorcraftinclude helicopters with powered rotors and autogyros with free-spinning rotors. For road use, a rotor must, like many naval helicopters, be either two-bladed or foldable. The quadcopter requires only a simple control system with no tail. The autogyro relies on a separate thrust system to build up airspeed, spin the rotor and generate lift. However, some autogyros have rotors that can be spun up on the ground and then disengaged, allowing the aircraft to jump-start vertically. The PAL-V Liberty is an example of the autogyro type.

Ducted-fan aircraft such as the Moller Skycar tend to easily lose stability and have been unable to travel at greater than 30–40 knots.

2. **Power**

The flying car places unique demands on the vehicle power train. For a given all-up weight, an aero engine must deliver higher power than its typical road equivalent. However on the road the vehicle must handle well and not be overpowered. Power must also be diverted between the airborne and road drive mechanisms. Some designs therefore have multiple engines, with the road engine being supplemented, or even replaced by, additional flight engines.

As with other vehicles, power has traditionally been supplied by internal combustion engines, but electric power is undergoing rapid development. It is coming into increasing use on road vehicles, but the weight of the batteries currently makes it unsuited to aircraft. However its low environmental signature makes it attractive, and it is expected to prove viable in the near future, at least for the short trips and dense urban environments envisaged for the flying car.

On the road, most flying cars drive the road wheels in the conventional way. A few use the aircraft propeller in similar manner to an airboat, but this is inefficient.

In the air, a flying car will typically obtain forward thrust from one or more propellers or ducted fans. A few have a powered helicopter rotor. Jet engines are not used due to the ground hazard posed by the hot, high-velocity exhaust stream.

3. Safety

In order to operate safely, a flying car must be certified independently as both a road vehicle and an aircraft, by the respective authorities. The person controlling the vehicle must also be licensed as both driver and pilot, and the vehicle maintained according to both regimes.

Mechanically, the requirements of powered flight are so challenging that every opportunity must be taken to keep weight to a minimum. A typical airframe is therefore lightweight and easily damaged. On the other hand, a road vehicle must be able to withstand significant impact loads from casual incidents while stationary, as well as low-speed and high-speed impacts, and the high strength this demands can add considerable weight. A practical flying car must be both strong enough to pass road safety standards and light enough to fly. Any propeller or rotor blade also creates a hazard to passers-by when on the ground, especially if it is spinning; they must be permanently shrouded, or folded away on landing.

For widespread adoption, as envisaged in the near future, it will not be practicable for every driver to qualify as a pilot and the rigorous maintenance currently demanded for aircraft will be uneconomic. Flying cars will have to become largely autonomous and highly reliable. The density of traffic will require automated routing and collision-avoidance systems. To manage the inevitable periodic failures and emergency landings, there will need to be sufficient designated landing sites across built-up areas. In addition, poor weather conditions could make the craft unsafe to fly.

Regulatory regimes are being developed in anticipation of a large increase in the numbers of autonomous flying cars and personal air vehicles in the near future, and compliance with these regimes will be necessary for safe flight.

4. Control

A basic flying car requires the person at the controls to be both a qualified road driver and aircraft pilot. This is impractical for the majority of people and so wider adoption will require computer systems to de-skill piloting. These skills include aircraft manoeuvring, navigation and emergency procedures, all in potentially crowded airspace. The onboard control system will also need to interact with other systems such as air traffic control and collision-risk monitoring. A practical flying car may need to be capable of full autonomy, in which people are present only as passengers.

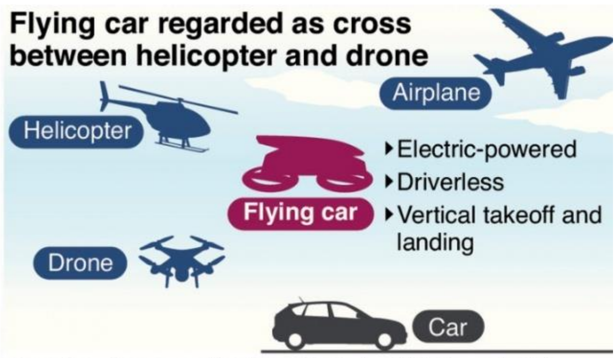
5. Environment

A flying car capable of widespread use must operate acceptably within a heavily populated urban environment. The clear environmental benefits of electric power are a strong incentive for its development.

6. Cost

The needs for the propulsion system to be both small and powerful, the vehicle structure both light and strong, and the control systems fully integrated and autonomous, can only be met at present, if at all, using advanced and expensive technologies. This may prove a significant barrier to widespread adoption.

Flying cars are used for relatively short distances at high frequency. They travel at lower speeds and altitudes than conventional passenger aircraft. Similarly, the flying car's road performance is compromised by the requirements of flight and the need to carry around the various extra parts, so it is also less economical than a conventional motor car.



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