

Study of Recent Manufacturing Trends towards Smart Automobile Vehicle

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Abstract This chapter describes these themes and thereby the current situation in the manufacturing landscape the current manufacturing industry is already transforming changing social mindset and government aim for sustainable production. This general trend is accompanied by globalization, increasing competition and changing markets, which manufacturing companies need to cope with. Next to these general trends the developments on 'Lean Manufacturing', 'TQM' and 'Logistic innovations' are more and more accepted supported by the ongoing acceptance of Information and Communication Technology 'ICT'. As mentioned this ICT developments are more and more visible in the inbound and outbound logistics of companies. Nowadays the manufacturing companies of Current time even cannot function without ICT guided logistics. Significant technological development has taken place, changing and reinventing how motor vehicles have been produced in the last 79 years. The manufacturing processes are now adopted to play greater role towards developments as aesthetical, aerodynamic, ergonomically comfortable design, with low periodic break down, highly fuel efficient and least pollution emitting motor vehicles. The complete process lines are almost undergoing automation to ensure quality, durability and cost effectiveness, resulting better future by way of sustainability of energy as well as adding to Fuel Saving & release of low emission to reduce Health hazards & Ecological imbalances. Since the fast depletion of fossil fuel has now a day become worldwide problem and technology has generally led to a greater use of hydrocarbon fuels for about 150 years, thus the decrease in supply of fossil fuel is making civilization vulnerable. The use of large number of vehicles for transport is also contributing to about 70% of total air pollution. In India vehicular pollution has also reached 8 times than it was 20 years before. Currently India is the fifth country which produces higher rate of emission and creating environmental & ecological imbalance after rating of USA, China, Russia & Japan. The world wide researches are going on and Japan has taken leading role for development of automobile vehicles at large. This paper covers the history of technological developments, use of CAD / CAM in designs, use of modern techniques for manufacturing processes & unconventional machining processes for vibration free, low noise and most balanced engines, use of sensor devices, development of alternative fuel efficient & low pollution automobile engines, tapping all other non conventional energy sources to develop fuel cell, battery operated, photocell and compressed air motor vehicles for future.

Keywords: fossil-fuel, pollution, fuel-efficient, motor vehicles, smarts materials, latest technologies

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1. Introduction

The trend of these sustainability is already present in the current industry and changes the future manufacturing landscape. This affects manufacturing companies in a way that they will have to produce quality products against a low price in a sustainable way. And Next to the sustainability aspect, three more topics: "ICT", "High performance manufacturing" and "Use of new materials" are identified as key factors to describe future trends. From the record, it is found that the first beginning of mobile vehicle was started in 1335, when several Italians designed wind driven vehicles. It was a wind mill type

drive to gears and thus to wheels. Later Leonardo Da Vinyl designed a clock work driven tricycle with tiller steering and a differential mechanism between the rear wheels. The Curved Dash Olds mobile had single cylinder engine tiller steering & chain drive were sold in 1901-600 for \$650 and the next year were in 1902-2500, 1903-4000, 1904-5000. The 200 automobile vehicles were produced in mass by Ford Company in 1903. The period marked end of the beginning of the automobile. The Rolls Royce Silver Ghost of 1906 was a six cylinder car that stayed in production until 1925, thereafter luxury Cars, Transport vehicles (e.g. Trucks, Buses, Passenger & Goods Trains with Steam Engine, Diesel Engine & Electric Motor driven vehicle took its larger pace to benefit the mankind and hence enriched the civilization.

The entire researches were concentrated to hydro carbon (e.g. fossil fuel) about 100 years before, when 2 Internal Combustion Engine took its developments. An American oil geologist Marion King Hubbert, in 1956 predicted that US oil production would peak in 1970 and decline thereafter. The “Hubbert Curve” illustrated practical availability of a region’s oil reserves over time describes a bell-shaped curve. After exploration and initial growth in output, production plateaus and eventually declines to zero and there could be crises of fossil fuel after 40 years. The lots of reserves were explored. A recent study made in 2004 predicted that if the hydrocarbon fuel /oil is consumed at the current rates, the consumption may reach to 80% of the entire available resource by 2020. On other hand larger use of fossil fuel have been contributing to high emission rate and raised the pollution level subsequently creating Human Health hazards & other subsequent problem of global heating penetration in ionosphere. India's vehicular pollution is estimated to have increased eight times over the last two decades. This source alone is estimated to contribute about 70 per cent to the total air pollution. With 243.3 million tons of carbon released from the consumption and combustion of fossil fuels in 1999, India ranked fifth in the world behind the U.S., China, Russia and Japan. India's contribution to world carbon emissions is expected to increase in the coming years due to the rapid pace of urbanization, shift from noncommercial to commercial fuels, increased vehicular usage and continued use of older and more inefficient coal fired power-plants. This necessitates the search for alternative of oil as energy source or preserving it by tapping some other alternatives such as Non-conventional energy like battery operated vehicles, wind mills, photocells etc. and to convert their output into mechanical energy, which may alternatively preserve oil source besides the development of most efficient and low pollution automobile vehicles. Today there is need of development of Smart Automobile Vehicles to make human life free from accident, to provide best comfort, low fuel consumption and emission free – zero pollution environments.

2. What are Smart Automobile Vehicles?

Today now, are we seeing new digital communications technologies, of the internet and beyond, that may eventually displace some of the functions of the automobile and replace our current problems with a new set that you, our grandchildren, will be charged with solving? Ask your grandparents about their first car. I'm sure you will get to hear a great story. But we want look for new dimension of automobile cars which may be free from all the current problems, those are being faced & beyond the manual control / mistakes which occurs and causes risk to human life. The car which satisfies following parameters may be placed under definition of smart auto-mobile vehicles:-

- Aerodynamic body & least weight
- Minimum road gap (i.e. distance between Centre of gravity and road)
- Larger wheel space
- Balanced, high speed & vibration free engine

- Noise free power gears & differential gears
- Moderate & strong chassis
- Comfortable interior & requisite facilities
- Fuel efficient & low emission
- Accident free on roads.

Thus the definition of Smart Automobile Vehicles / Cars sounds more than what we ultimately desire for better riding, pollution free environment for the society and to contribute to modern civilization. The answer lies with microprocessor / sensor based control over speedy run, braking system, overturning, global positioning systems, tracking for sides, front & back running / standing vehicles or objects. This needs attention on use of high strength alloy material, use of CAD / CAM & CATIA for designing, use of modern techniques for manufacturing processes & unconventional machining processes for vibration free, low noise and most balanced engines, development of fuel efficient & low pollution automobile engines, alternatively tapping all other non conventional energy sources to develop fuel cell, battery operated, photocell and compressed air motor vehicles to overcome the future problem of depletion of fossil fuel. Electrically operated motors or Compressed Air / Gasoline operated turbines are the solution for vibration free, comfort riding and longer lasting vehicles.

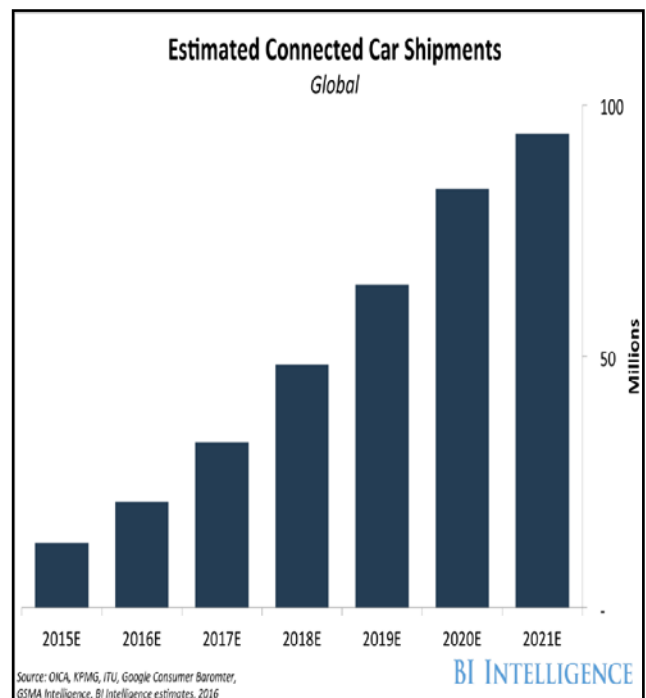


Figure 1. Estimated Connected Car Shipments

3. Modern Trend in Designing Processes

Today’s world moving forward to design most sophisticated components of vehicles in very short time. The use of Computer Aided Design, Computer Aided Manufacturing and CATIA to prepare drawing as well as working models to evaluate its functional working is found effective solution. The use of 7 CATIA is very rapidly taking its pace worldwide for aerodynamic body as well as parts where indigenous shape are required to be given.

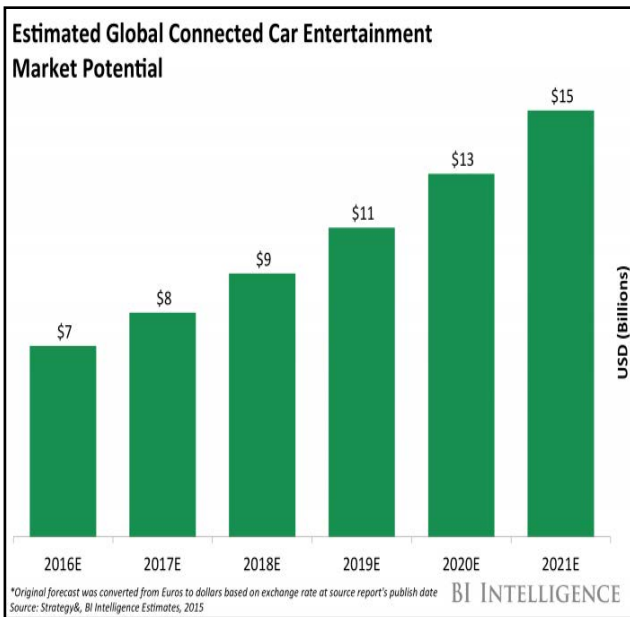


Figure 2. Estimated Global Connected Car Entertainment Market Potential

4. CAD, CAM & CATIA V5 for Automotive Design

CATIA is the world's leading CAD/CAM/CAE software. This software gives you a broad range of integrated solutions that cover all aspects of:

- Product design & manufacture.
- Driving enterprise competitiveness
- Task productivity Process improvement.

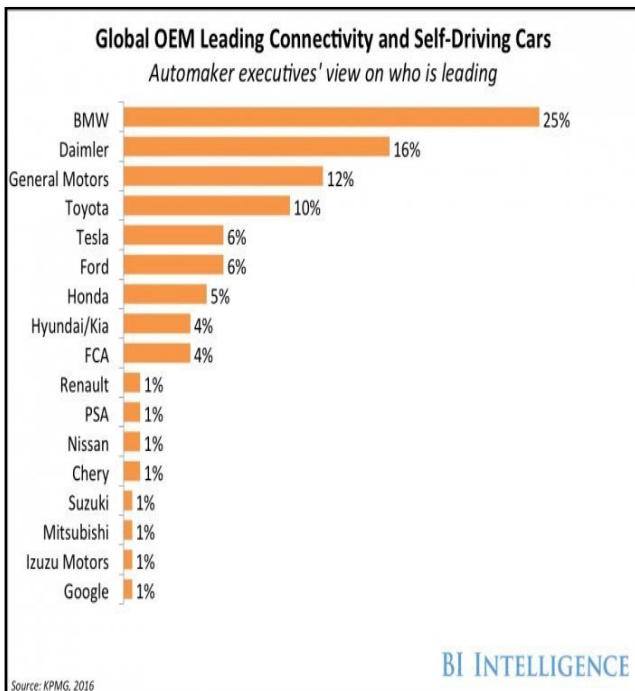


Figure 3. Global OEM Connectivity and Self-Driving Cars

CATIA (Computer-Assisted Three Dimensional Interactive Application) is acclaimed throughout the world as the leading program for use in design. CATIA offers

unequalled scope of functionality, together with total integration of all its functions, thereby ensuring that its users are able to address the most challenging design tasks, and then translate those into realistic, manufacturable products. It also opens up new frontiers in Concurrent Engineering, leading to better designs, at lower cost, in significantly shorter time. With a development history stretching over more than 15 years, CATIA has proven itself in every imaginable industry, and with the availability of Release 5, which operates on a PC platform, is accessible by even the smallest of manufacturers. Use of CATIA V5 is being done very rapidly by MIRA, a leading independent design, development, testing and research organization which provides a service to the worldwide automotive industry.

5. Modern Trend in Manufacturing Processes

Keeping in view of worldwide problem of fast depletion of fossil fuel and use of higher rate of vehicular transport causing high pollution, necessitate modern trend in manufacturing process for automobile engine, which may run with very high efficiency and consume very less fuel. It should also emit least pollution & satisfy pollution limit as per the act, while the automobile is a commonly used product; it is an extremely complex and technologically sophisticated one. Manufacturing new cars requires state-of-the-art technological methods and processes. Also includes in addition, supplier industries of the automotive manufacturing industry, such as steel and other parts as well as electronic instrumentation, are vital in providing the necessary supplies and components for assembling motor vehicles. To improve product quality and efficiency in production, automakers invest a large amount of time and money into developing and improving the manufacturing process, and rely heavily on research and technological innovation. Modern technologies used in advancing manufacturing for the automotive industry include:

Programmable machines and tools-Robotics --- High speed data communication and data management-NC & CNC machines --Supercomputing-Product & Process developments Virtual manufacturing and complex visualization techniques-Modeling & evaluating by CAD, CAM, CATIA & Pro-Engineers Advanced techniques – Unconventional machining, forming & forging. Over the last 25 years, automation technology has become an essential part of automobile assembly plants. A typical assembly plant uses several hundred robots to build and paint the vehicle frame. While robotic technology continues to grow in assembly plants, the technology does have limitations, especially in performing more delicate tasks. The advent of Intelligent Assist Devices, in particular Cobots (Collaborative robots), aided in reducing ergonomic concerns, while also improving safety, quality and productivity. Cobots, developed by Northwestern University and General Motors Corporation, are designed to work in collaboration with human operators to move objects and perform physically demanding tasks on vehicle assembly lines.

6. Elements of Automobile Manufacturing

- Cost Technology and Process
- Durability Workforce and Organization
- Product Development Logistics and Supply Chain Process
- Development Research and Engineering Flexibility Interface
- Facilities Equipment In looking at trends in global automobile manufacturing, Japanese automakers have been leaders in stream-lined manufacturing process systems.

These methods have been adopted by manufacturing plants worldwide.

7. Automobile Technology & Innovation

Due to competitive market pressure, the product life-cycle for automobiles continues to be shortened. It forces 9 automakers to dramatically redesign car models every four to five years. New technological developments have led to unique and innovative designs for future automobiles. Automobile manufacturers use the development of new technologies to enhance performance capability, as well as to create innovative designs. Alternative fuel technologies, such as electric hybrids and fuel cell cars, have received considerable attention, and demonstrate attempts to design vehicles that are more energy efficient and greatly reduce engine propulsion reliance upon fossil fuels and more to looked for energy conversion like compressed air or zero pollution vehicles

7.1. Electric Powered Vehicles

Currents movement towards electric powered vehicles began as a result of the 1973 Oil Embargo, in which efforts were made to utilize electric battery technology to power engine propulsion. However, problems and limitations regarding driving range, speed and a very small market, all led to automakers GM, Ford, Honda and Toyota discontinuing their electric vehicle programs during the late 1990's.

7.2. Hybrid Powered Vehicles

The Hybrid vehicles combine two or more sources of power, which are able to operate using a rechargeable battery and gasoline. Production of gas-electric hybrids signifies the first significant move away from total reliance on the internal-combustion engine in nearly a century. Hybrid vehicles are highly fuel efficient and present the first major step toward fuel cell vehicles, according to industry specialists. Japanese automaker Toyota is one of the auto industries leaders in hybrid vehicle research and production with its Prius model. General Motors, also involved in producing hybrid vehicles, will be introducing and mass producing its hybrid model by 2007. Most major automakers plan to introduce hybrid vehicles to the market within the next five years.

7.3. Fuel Cell Vehicles

The fuel cell powered vehicles, in particular hydrogen fuel cell powered engines. Fuel cell systems operate by compressing hydrogen made from natural gas and gasoline, which is then converted to hydrogen by on-board systems. Automobile industry and suppliers worldwide are investing substantially in the development of fuel cell systems. General Motors (GM), Ford and DaimlerChrysler have invested billions of dollars in a collaborative project to develop hydrogen fuel cell technology. Industry GM is perhaps the most active in investing, as well as researching and developing fuel cell technology. However, many industry specialists indicate that fuel cell technology will not be available on the commercial market until the next 10 to 15 years. There are, however, problems associated with hydrogen fuel systems which consist of:

- Fuel cell vehicles will be more expensive
- Fuel cell cars will require a new infrastructure for vehicle manufacturing and maintenance
- Developing a system for producing and distributing hydrogen fuel many uncertainties remain regarding the development and use of hydrogen fuel cell technology, as well as addressing the major question on how to create a viable infrastructure that supports the use of fuel cell vehicles.

7.4. Compressed Air Light Vehicles

The Korean inventor "Beau de Rocha" (Otto) developed zero pollution cars using Quasi turbine with a set of 14- engines parameters and disclosed on Sept'2005 using gasoline. Scientist "Guy Negre", a French Scientist, in 1998 developed compressed air- 4- cylinders engine run on air and gasoline, claims zero pollution cars and got 52- patents registered since 1998 to 2004. The car was demonstrated in Oct.'2004 publically. "E.J. Honton" an USA based inventor in April'2004 presented the Hydrogen Fuel Cell Car at 15th Annual US Conference & Hydrogen Expo, USA and projected the scope of its market in different country. Latest Air turbine was developed by Indian scientist and got patent in 2011 on the concept of rotary turbine which are used in bike and second.

7.5. Google Driverless Cars

In today scenario on the onset of winter break, on December 23, Google announced its first fully functional driverless car, which is ready for testing on public roads. Before to this technology the Internet giant developed various prototypes that lacked on different fundamental and functional aspects. The latest prototype has all the important elements like headlights, steering and brakes. The manufacturing company has also created a self-operating system with sensors and computers that can be fitted to SUVs like Lexus. This new latest technology will not only be a breakthrough in tough traffic congestion but sensing technology can also increase road safety. Countries such as the UK and US are working on laws to allow driverless cars concept.

7.6. Automated Manual Transmission (AMT)

In last 2014 Delhi Auto Expo, where more than 70 vehicles were launched, one that pundits hailed as the

most important was Maruti Suzuki's Celerio, the first affordable mass segment gearless hatchback. Celerio comes with AMT (automate manual transmission) sourced from Magneti Marelli, component arm of Fiat. AMT is an electro-hydraulic mechanism for automating manual transmission, which derives from Formula 1. It has a hydraulic system and an electronic system. The electronic transmission control unit helps in engaging and disengaging the clutch and gear through an electronic actuator. It also has a sports mode, which enables drivers to move to the manual shifting of gear to increase and decrease the gear ratios with plus and minus either through gear knob /joystick or the steering. In India, AMT is currently available in three car Celerio, Alto K10 and Tata Zest.

7.7. V2V Communications

In February, US National Highway Traffic Safety Administration announced that it will begin taking steps to enable vehicle-to-vehicle (V2V) communication technology for light vehicles. This technology would allow vehicles to "talk" to each other and ultimately avoid many crashes altogether by exchanging basic safety data, such as speed and position, ten times per second, to improve safety. It uses 'ad hoc network', where every car is free to associate with any other car available in the network and share equal status. V2V, which is also known as VANET (vehicular ad hoc network), is a variation of MANET (mobile ad hoc network). Many automobile manufacturers including are BMW, Audi, Honda, General Motors, Volvo and Daimler working and developing this technology to improve safety, overcome blind spots and avoid accidents

7.8. Pre-Collision Technology

Top carmakers such as Ford and Hyundai have developed a pre-collision assist and pedestrian detection technology. Besides helping the driver detect blind spots, this technology also alerts the driver when he/she is not paying attention on the road. And if the driver falls asleep and does not respond to the warning, then the system applies the brakes on its own. The driver assist system has two types of sensors. One is millimetre-wave radar located inside the front grille, and the other is a monocular camera mounted on the upper, inside part of the windshield. Its collision mitigation braking system delivers an audio and visual warning when there is a risk of a head-on collision.

If the driver fails to react, the car will automatically begin breaking itself to prevent or reduce the severity of a crash. This technology will debut in 2015 with Ford Mondeo in Europe. Hyundai would introduce it.

7.9. Smart Cars

After smart phones, we will soon have smart cars around. In June 2014, Google launched its 'Android Auto', telemetric software that can be connected to car dash board for infotainment. It also enables the driver to access GPS, maps, streaming music, weather, and a host of other applications. A slew of carmakers including Barth, Acura, Alfa Romeo, Audi, Bentley, Chevrolet, Chrysler, Dodge,

Fiat, Ford, Infiniti, Jeep, Kia, Maserati and Volvo will offer Android Auto. Earlier, at the Geneva Motor Show in March, Apple announced its 'CarPlay' software, which allows devices running on the iOS operating system to function with built-in display units of automobile dashboards. Carmakers like BMW, Daimler, JLR, Honda and Hyundai have installed it in their cars. Infotainment manufacturers like Pioneer & Alpine too have shown interest in Carplay from Apple.

7.10. Ford Aluminium Truck

In 2014, Ford unveiled the first aluminium-bodied full-size pickup, rolling out aluminium version of its popular F-150 from its Dearborn plant. It is 700 pounds or about 318 kg lighter than the steel-bodied version, making it a more fuel-efficient and nimbler pickup. The F-150 has been the best-selling vehicle in the US for 32 straight years. Last year, Ford sold nearly 100,000 more full-size pickups than General Motors. Aluminium isn't new to the auto industry, but this is the first time it will cover the entire body of such a high-volume vehicle.

7.11 Bus Powered by Human Waste

In November, the world witnessed the first ever bus to run on human waste on the roads of Britain. According to researchers, the bus can provide a sustainable way of fuelling public transport — cutting emissions in polluted towns and cities the 40-seater Bio-Bus, which runs on gas generated through the treatment of sewage and food waste, helps to improve urban air quality as it produces fewer emissions than traditional diesel engines. The bus can travel up to 300 km on a full tank of gas.

7.12. Land Rover's Invisible Car

In April, Tata -owned JLR introduced a new technology to give drivers a digital vision of the terrain ahead by making the front of the car 'virtually' invisible. The technology — named Transparent Bonnet — enables a driver climbing a steep incline or maneuvering in a confined space to see an augmented reality view capturing not only the terrain in front of the car but also the angle and position of the front wheels.

The cameras located in the vehicle's grille capture data used to feed a head-up display, effectively creating a 'see-through' view of the terrain through the bonnet and engine bay, breaking new ground in visual driver assistance.

7.13. Toyota's Hovering Car

Toyota is developing a future airborne car. A media report quoted Hiroyoshi Yoshiki, managing officer at Toyota Motor Corporation, as saying the company has been toying with the idea of flying cars. The concept car being developed at one of Toyota's high tech R&D centres won't be actually flying around, but instead would be floating slightly above the road to reduce friction, a bit like a hovercraft. This is just a case-study and the actual Toyota hovering car may not make it to the showrooms anytime in the near future.

8. Advanced Product Design and Operating Systems for Smart Vehicle

As we discuss over in Modern automobiles are increasingly relying upon more advanced electronics, computer, and wireless communication systems to assist drivers or driverless and enhance safety. These technologies replace mechanical systems that power, steer and brake the vehicle. Most vehicles have several computers, with high-end models having a half dozen or more that control functions, which range from shifting gears to operating GPS navigational systems. And also arinudo software as well as Alcohol detector are also used to latest technique GM has introduced the Autonomy concept model, which uses hydrogen fuel cell technology that powers electric motors in each wheel. The vehicle uses a chassis and replaceable body, allowing greater flexibility and freedom in designing the interior. Internally, the vehicle operates without pedals or dashboard, using sophisticated computer and electronic systems to operate the vehicle. Voice activation is another technology being developed for use in future vehicles. Voice activation systems are expected to operate internal climate controls, open doors, and air bag also used for safety for respond to navigational request by the driver. The next step in automobile electronic and communications technology is vehicle sensor technology. Sensor technologies use radar or laser technology to control systems that detect vehicles in front which then automatically slow down the vehicle. Companies are using sensor technology to serve as collision-avoidance systems that operate and control vehicle safety systems and on-board equipment.

9. Future Perspective

- **Sustainable manufacturing:** These aims will address at the same time:
 - Environmental friendliness.
 - Economic growth.
 - Social well-being.
- **ICT-enabled intelligent manufacturing:** In the future the further implementation of ICT services will positively affect efficiency, sustainability and quality of the manufacturing industry. Although integration of ICT can be costly and time consuming it is a key enabler for improving manufacturing systems at three levels:
 - Smart factories: agile manufacturing and customization.
 - Virtual factories: value creation, global networked manufacturing and logistics.
- **Digital factories:** Manufacturing design and product life cycle management High performance manufacturing and equipment Flexible adaptive production equipment, systems and plants.
 - High precision micro-manufacturing machines and systems.
 - Tools for production planning and adaptive manufacturing systems.
 - Zero-defect manufacturing.

- **Exploiting new materials through manufacturing:**
 - Net-shape manufacturing for advanced structural and functional materials.
 - Product design using sustainable material processing technologies.

10. Conclusion

In view of growing requirement of materials and its use according to basis of weight and strength and fuel & energy, fast depletion of fossil fuel and change in living style, it has become inventible to look into alternative energy source, develop energy efficient & accident free automobile vehicle using all advanced techniques of design, developments, manufacturing, testing for zero defect and adopting sensering devices so called SMART AUTOMOBILE VEHICLES. Following conclusions are drawn from current study:-

- Fuel efficient vehicles can add sustainability to fuel energy resource.
- Fuel efficient vehicles can release low emission & reduce pollution hazard.
- Use of electric motor, hybrid power vehicles, hydrogen cell vehicle and compressed air vehicles will overcome the sustainability problem of fossil fuel. Air has enormous potential and can be the best alternative to fossil fuel driven vehicles.
- Trend to adopt advanced technique for design by CAD, CATIA will improve the look, comfort & durability of future Automobile Vehicles apart from its running.
- Trend to adopt advanced manufacturing processes / development / robotics will cut down cost as well as improve the efficiency of Auto Mobile Vehicles.
- Trend to adopt electronic & communication sensor will detect vehicles in front / sides and back, which then automatically slow down the vehicle. Using latest sensor technology to serve as collision avoidance systems that operate and control vehicle safety systems and on-board equipment.
- Voice activation is another technology being developed for uses in future vehicles for opening-closing doors and other devices. Thus the dream of Smart Automobile Vehicle will definitely change the future and will be the best alternative to the need of day.

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