**[Текст 1](https://lms.guap.ru/mod/assignment/view.php?id=24926" \o "ТЕКСТ 1).**

**Automation in the research process**

Our goal should be automating the routine and thereby leave  
more time for the creative process. With that word of caution, let's proceed by  
arbitrarily dividing research into three stages and examining. Each stage to  
find what functions of the research process might be automated without endangering  
 creativity. Stage one includes the  
dreams, the ideas, the exploratory work, selecting the problem, setting the  
objective, testing technical feasibility, and searching the literature. Stage  
two involves planning the experiment, conducting the experiment, checking the  
alternates, data taking, and data evaluation. Stage three is the solution of  
the problem — drawing conclusions and making recommendations. Although there is  
a great deal of creativity involved in state one, there are also opportunities  
for automation. The burden of keeping up with the literature even in one's own  
restricted field is becoming heavier with each passing year. The mass of  
reading necessary to make a literature search has increased immensely. Advances  
in computer technology have made possible storing and quick retrieving essentially  
all the scientific literature.

**Satellite design and construction**

- the elements that need to be considered for satellite design and construction, and satellite systems design and other factors relating to the design of a satellite.  
Satellite design and construction is a particularly specialised business. The requirements for satellites are very stringent and satellites must be capable of operating in extreme conditions whilst still maintaining the highest standards of reliability because they cannot be retrieved for maintenance or repair. Apart from the general factors relating to satellite design, the circuitry required for their operation such as the transmitters and receivers, satellites also contain a number of systems used for what is called station keeping. All of these functions, whether for performing the primary role of the satellite, or for ensuring that it reliably maintains its position and function are all important and must be included in the design of the satellite.

**Satellite position maintenance**

Satellites need to be kept in the correct position. Although they may be placed in exactly the correct orbit after they are launched, the variations in the Earth's gravitational field and other factors may cause them to drift out of their correct position. As a result it is necessary to reposition them periodically.  
Small thrusters are used to perform this operation. Often they consist of canisters of a gas which when released with a catalyst gives a form of rocket propulsion to move the satellite back on station. Often the service life of a satellite is determined by the amount of fuel for repositioning the satellite rather than the reliability of the electronics.  
The other problem with a satellite is that its attitude will change. This is of great importance because directive antennas or cameras are often used, and the satellite needs to be orientated in the correct direction for them. The basic method of gaining the correct orientation is to use the thrusters. However the attitude will change comparatively quickly. The most common method to overcome this is to use the gyroscopic effect. Sometimes a large flywheel may be made to spin inside the satellite. This can be inefficient in its use of the weight of the satellite. To overcome this other cylindrical satellites actually rotate a portion of the body, often an inner cylindrical section so that the antennas mounted on the outer section do not revolve.

**Satellite power**

Electrical power is also required by the satellite for its electronic circuitry and other electrical systems. Although the power requirements for some satellites may be relatively modest, this is certainly not the case for satellites such as direct broadcast (DBS) or satellite television broadcasting satellites. Although they do not transmit the same levels of power that are used for terrestrial broadcasting, they still consume considerable amounts of power.  
The power is supplied by the large arrays of photo or solar cells. Some cylindrical satellites have them positioned around the outer area on the cylinder so that some part of the body is always exposed to sunlight. Others have large extending panels that are orientated to collect the maximum amount of light. Today these panels are capable of producing the many kilowatts of power required for the high power output stages used in many transponders.  
Batteries are also needed for the periods when the satellite is in darkness. These need to charged by the solar cells so that when the satellite passes out of the sunlight it can still remain operational. This naturally places an additional burden on the solar cells because they need to be able to power not only the satellite itself, but also charge the batteries. This may double the power they have to supply during periods of sunlight.

**Satellite antennas**

The antennas used on satellites are particularly important. They are the only means through which communication can take place with the ground. For geostationary satellites directional antennas are generally used. These are used because power consumption on the satellite has to be minimised wherever possible. Directional antennas provide gain and enable the best use to be made of the available transmitted power. Additionally they enable the signals from the earth to be received with the best signal to noise ratio. In view of the long path lengths required for geostationary satellites, there is a considerable path loss and the antenna gain is used to improve thereceived signal strength. It also helps reduce the reception of solar and cosmic noise that would further degrade the received signal. In a geostationary orbit the earth subtends only 18 degrees of arc. Any power not falling into this area is wasted. As a result, parabolic reflector or "dish" antennas are widely used. Horn antennas are also popular and in some cases phased arrays may be employed, especially where coverage of a specific area of the globe is required. However the use of directional antennas does mean that the orientation of the antenna is crucial, and any perturbation of the alignment of the satellite can have a major effect on its operation, both in reception and transmission. The situation is different for low earth orbit or LEO satellites. These satellites are not in geostationary orbit and they move across the sky. Additionally they may need to be received by several users at any time and this means that they cannot use directive antennas. Additionally the earth subtends around half the celestial sphere and as a result users may be separated by angles ranging from zero to almost 180 degrees. Fortunately the satellites are much closer to the earth and path losses are very significantly less, reducing the need to high gain antennas.

**Environmental**The environment in which satellites operate is particularly harsh. Combined with the need for exceedingly high levels of reliability resulting from the near impossible task of repair, this means that every detail of the design and operation under these conditions must be carefully considered.  
In the first instance the temperatures range over very wide extremes. The surfaces exposed to the sun are heated by solar radiation and will rise to very high temperatures, whereas the other side that is not heated will be exceedingly cold. Only conduction will give any heating effect under these circumstances. The temperature of the whole of the satellite will also fall when it is in darkness.  
There are a number of other effects that must be considered. Solar radiation itself has an effect on some materials, causing them to degrade. Notice must also be taken of meteorites. Very small ones cause the surfaces to be eroded slightly, but larger ones may penetrate the body of the satellite causing significant damage. To overcome this satellites are protected by specially designed outer layers. These consist of sheets of metal which are slightly separated giving a cushioning effect when any meteorites impact on the satellite. Cosmic particles also degrade the performance of satellites. Particularly during solar flares the increase in solar particle flow can degrade solar cells, reducing their efficiency.

**Ground stations**

Ground stations also need an effective antenna system. For communication with satellites in geostationary orbit the antenna remains fixed, except if there is a need to change to another satellite. Accordingly parabolic reflectors are often used. This can be seen from the number of satellite TV antennas that are in use. These are a form of parabolic reflector. This type of antenna is widely sued for example with direct broadcast satellite TV. The antennas seen on the sides of houses are almost exclusively parabolic reflectors. However it is possible to use other types such as arrays of Yagi antennas. Here they are stacked (one on top of the other) and bayed (side bay side) to give additional gain.For some low earth orbit satellites the ground station antenna systems are designed to be able to track the satellite in azimuth and elevation. This is typically achieved by automatically tracking the satellite as it moves across the sky. This is normally achieved by taking a signal level output from the receiver. By ensuring that it is maintained at its peak level the satellite will be tracked. Many low earth orbit satellites are required for systems such as positioning or even telephone style communications. Here directional antennas are not used as the user will not want to re-orientate the antenna all the time. Instead almost non-directional antennas are used and the transmitter powers and receiver sensitivities designed to give a sufficient level of signal to noise ratio. This is the case for GPS where several satellites need to be received at the same time. Accordingly receivers are designed to accommodate the very low signal levels.

**Satellite design summary**

Satellites are in everyday use around the globe. Not only are functions such as GPS widely used, but so are many other forms of satellite including communications satellites, weather satellites, geophysical satellites and many forms of satellites. Without them, our lives would be very different, and we have come to rely on them. Accordingly their design must be made to be very reliable as they are not easy to repair, even if it is viable - which is normally not the case, and they operate under extremely harsh conditions. Accordingly the design of a satellite is critical. The satellite design specifications need to be totally correct, and the basic satellite design needs to take all aspects into consideration, making any satellite design project particularly exacting. However if correct, the satellite will normally be able to give many years of service and pay for the large investment in the satellite design and construction.  
*By [Ian Poole](https://plus.google.com/104687638164370436625?rel=author" \t "_blank)*

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