

**Systems Engineering**  
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**Lecture - 17**  
**Demonstration of real life systems by the Indian Army**

Everyone who is listening to this video, this is actually one of the theoretical demonstrations related to systems and the everything about how different system; how different defense systems are being used in the field. So here is a small example of a scenario where the brave soldiers of our country are defending the border of our nation. So you already seen the setup as a part this and here is a war, small war like scenario where the officers from different units.

The surveillance, the mechanized infantry and artillery units will be explaining about how they utilized different of the tools and equipments to do the do this job of protecting the border of the country. So I would like to introduce officers from three corps in this. One is one of the officers from the artillery corps and there is also officer from mechanized infantry; the tank division and there is officer from SATA Division SATA is where they actually locate the enemy.

So [Foreign Language Starts: 01:16] Would you like to, for the information lot of this lecture will be in Hindi or lot of the video stuff will be in Hindi and appropriate subtitles will be provided later for people who do not understand Hindi. [Foreign Language Starts: 01:29] Sir please give an overview about the systems. Sir, I belong to SATA regiment, I am a CSDT commander. CSDT means composite surveillance and degradation team, we are deployed upon IB.

The deployed system consists of one radar -ELM 2140 and one LOROS both made by Israel. Whichever input from the enemy side we get, we send them to the higher authority so that we can understand every movement of the enemy so that we can alert our soldiers regarding the present position of the enemy and enemy movement can be prevented. I am Naib Risaldar Amrindar Sharma. I belong to 76 armor regiment. Armored regiment do not hold the ground.

We move the battlefield by destroying enemies. We move in front such that the ground army can follow us. To do this job it is necessary for us to use the tanks in proper way and we have

excellence in using these tanks in the battlefield. I am Subedar Pradip Kumar. I belong to Artillery 141 medium regiment. Our job is to support our army by means of fire support. We get locations from observational posts depending upon that data.

We lay our guns and fire on the enemy locations with perfection and destroy the enemy posts. Our infantry gives fire support to Armored and Supported arms. [Foreign Language Ends: 03:26]

So one thing is a before sir get into the picture, we would also like you to say few words about how this whole idea. How all these battlefield scenario has been sorted out? So myself Lieutenant Vikas I am into 1241 medium regiment that is located in Allahabad actually and this thing we have planned a Volex scenario behind this the LCs are there and the line of control just near the line of control, we have these SATA equipments and after that we have the our armored and then the covering firing provided by the arti support.

So the main idea is to show that how beyond the LC how we surveillance actually through the LOROS, ELM and DIGICORA, with the help of DIGICORA that is the SATA will be providing all the data regarding this and whatever the data inputs are then given by the SATA regiment, that is given to the fighting elements. There are the armored and then the artillery and on the basis of that we work.

So we will be having, this was a brief introduction about the all this thing and we will be having a detailed about each and every of them. That is it, sir. [Foreign Language Starts: 04:42] Apart from surveillance, we are also capable of DDOAF. That is we can give direction of own artillery fire. This can be obtained by using both ELM and LOROS [Foreign Language Ends: 04:58]

Now, we will look into the individual systems that are part of this all setup. So first we would actually ask you to talk about the whole systems on how do we get the data of enemy. [Foreign Language Starts: 05:10] First of all, I would like to introduce you with the radar. First of all, we deploy our radar to see any movements of the enemy. This can detect enemy movement from long range.

We also deploy LOROS, such that we can find the actual movement of the enemy, how big the enemy size is or from which side the enemy is moving. We collect their locations and pass it to the headquarter. Headquarter than pass that data to fired unit or armored unit or infantry unit and armed forces move accordingly. This is radar head and that is LOROS system. Radar head is detecting the enemies. Whichever it detects it sends the information to the control unit.

The main features of the radar are as follows; it works on Doppler shift it can detect a walking man from 15 kilometers, group of man from 18 kilometers, small vehicles from 25 kilometer, big vehicles such as tanks from 40 kilometer, helicopters 25 kilometer, artishell 15 kilometer. Its scanning sector is 10 degree to 360 degree. Elevation angle plus 6.5 degree to minus 6.5 degree. Operating voltage 25 volt. Now LOROS will be discussed.

It is long range reki and observation system. It has two camera. A VSS camera and a LOROS camera which can surveillance in night. The thing mounted over this is used to achieve the required range. A motion control system is mounted at the center which is used to operate the entire system. A control unit is also given which can make the suppression up to 100 meters. It also made by Israel. Horizontal scanning range 360 degree.

Elevation scanning minus 45 degree to plus 45 degree. The scanning speed is 15 degree per second. Input voltage 28 volt. Range performance of day camera is 13 kilometer, night camera's range performance 16 kilometer, LRF's range performance 20 kilometer. Primary task of this system, as said earlier, is surveillance similar to radar. Secondary task is DOOAF. If required it can work as an OP as well.

Accuracy for the static target is plus minus 3 meters; plus minus 14 meters in morning. It can save 9801 targets in the memory. Its camera can work in three field; wild, medium and narrow which are used as per requirements. Here these two observation system are placed. We can place them in 100 meter separation from each other.

Whichever information input we receive regarding the enemy, we pass it to the headquarters. Thanks. This is tank T 72 M. 45 number of tanks are included in one unit. We are from 76

Armored Regiment the bio data of the tank is as follows. First of all the name of the tank is T72 M1 Ajay. It is a medium type tank. Weight 42.3 ton. The tank requires three crew members; driver, gunner, commander. Power to weight ratio, 19.02 hp per ton.

Trench crossing 2.6 - 2.8 meter. If our infantry have made a trench within this limit, then we can easily cross that trench. Maximum gradient 30 degree. That means we can cross gradients up to 30 degrees easily. Engine specification 780 BHP, 2000 rpm. Performance average performance within cross country, 35 - 45 kilometer per hour. It can reach up to 50 kilometer per hour in highways. Maximum is very much significant for this tank.

When tank moves from the water, then we can cross from minimum 1.2 meter, medium flooding 1.8 meter, deep flooding 5 meter. This means when we go to any area inside Pakistan or in any other places, then we can go through the water to cross the obstacles. It can move through water for 1 kilometer. The major armament is main gun. It is a 125 mm caliber smooth gun. It has two secondary armament. They are 7.62 mm PKT, 12.7 mm PKT. It consists of multi fuel engine.

Which means the engine can be started with multiple fuels such as DHPP alpha, petrol, K2 etc. As I said it can move through deep flooding. After that the tank is equipped with smoke directive equipment. This equipment can be used to produce smoke screen to hide from nearby enemy tank. It is also equipped with NBC protection system. This is very much important for today's warfare.

During NBC warfare, this system can detect gamma ray and have the capability to keep the tank and crew members safe. It has a smoke directing launcher. A self-digging plate is also placed in the tank. You can see the self-digging equipment. It can take 1 - 2 minute to open this equipment and it can operate within 5 minute. The tank has a fire fighting system, which gets on automatically when the temperature inside the tank goes above 140 degree centigrade.

The tank is capable of doing auto loading for firing, though one can do manual loading also. If the enemy is nearby but we cannot understand the range, then we fire the laser first. This laser informs us about the range and we fire accordingly to destroy the enemy. The system which I am

now going to show you now came from Alwar. I am Subedar Sohan Singh. Previously I briefed about surveillance. Now I will brief you about DIGICORA mat system.

This DIGICORA mat system is built by Finland. It requires 45 minutes to start its action. It is handled by 7 men crew. The shell fire armed artillery unit travels through the air for 24 to 30 seconds. This travel, air travel is affected by the pressure, temperature and humidity of the air. So in order to rectify these effects, we launch a balloon in the air which consists of a radio sound. The balloon is filled with hydrogen gas for launching.

To generate hydrogen gas 2 kg caustic soda, 1 kg metal silicon powder and 1 kg granules are used. Along with this hydrogen gas, balloons of different weight depending upon the air where it is supposed to be sent is launched. 350 gram balloon is used for hard level, 200 gram balloon is used for lower level than this. Depending upon the area requirement we launch balloons.

The hydrogen generator generates hydrogen by mixing all these chemicals along 13 liters of water. It requires 45 minutes to produce hydrogen gas in the gas generator. Whenever the hydrogen gas gets prepared, the balloon weight 350 gram or 200 gram or any other required weight is placed on the balloon launcher. The balloon is then filled with hydrogen gas such that it should not burst before release.

When these accessories become ready we switched on the DIGICORA mat system then we do dry sounding and launch the balloon such that we can get the pressure, temperature and humidity of the space. This equipment also works on Doppler shift. It requires 220 volt ac power. A 4.5 KVA generator supplies the required power for this system. The antenna visible above is an UHF antenna. This antenna connected with the radio sound wave within 200 kilometer radius.

The communication range of this equipment is from 400MHz to 406 MHz. A GPS antenna is placed with this system which provides us the position of the ground station. The three antennas placed above this system is called DTR 11 antenna. Wind gauge, wind speed, humidity, thermo probe is attached with this antenna. This provides us the pressure, temperature and humidity at the ground station. Thank you. Now we will take you to the DIGICORA control system.

Now we will talk about the control system of the DIGICORA. This is the UPS. It is 8 KV it is used for power backup. This is main processing unit. This thing entire is operating system. This is digital barometer. This gives the humidity pressure to the ground station. This provide the wind direction and wind speed. This provides the temperature and this provides pressure to the ground station with data.

We get we can get 5 types of data: surface to surface gun scale, surface to air gun scale, computerized data for BOFORS guns, mat TA target accurization and mat FM. These 5 types of data we can issue to any department which requires in print out format. First of all I will tell about the general information regarding 130 mm M-46 gun. The caliber of this gun is 130 mm, maximum range 27490 meter.

Angle of elevation minus 0.2 degree to 45 degree. Top traverse 50 degree which is 25 degree right and 25 degree left. 3 - 4 minutes requires to bring this gun into action. This gun requires 9 men to fire. The life of barrel is 1600 round. Weight of gun, 8450 kg. Length of barrel, 7.6 meter. Rate of fire, intense. 2 rounds in a minute, rapid 1 round in 40 seconds, normal 1 round in 60 seconds, slow 1 round in 90 seconds, very slow 1 round in 3 minutes.

[[Foreign Language Starts: 26:50] [Foreign Language Ends: 23:37]

Now, I will tell about major parts of this gun: muzzle, barrel, recuperator, buffer, recuperator, sealed, wheel, trail, breechblock, breech ring, transversing hand wheel, alleviating hand wheel, sleigh, telescope. Now I will tell about this gun's drill. First of all we get GR from the OP. The GR points are worked out at the command post. The gun is operated based on the location data. I will demonstrate now. [Foreign Language Ends: 24:49]

[Foreign Language Starts: 26:50] And the process continues according to the information we get from the observation posts regarding the enemy positions. [Foreign Language Ends: 27:08]

[Foreign Language Starts: 28:35] I am Nayab Risaldar Amarinder Sharma 76 Armored Regiment. I have driver Jai Bhan with me, who drives this tatra truck. This is tatra 8 by 8, that has drive in its auto wheel.

This tatra transports heavy goods such as a tank. When we travel through difficult or mountains terrain, it is equally important to provide protection to this truck for which NBC protection system is installed in it. It can keep it safe during battle using NBC system. It also has capability to travel to water, provided the level and condition of land is good. The self-load and drag a tank along as well.

Fuel capacity of this tatra is 460 litres, with 12 cylinder, 780 bhp air cooled engine. Its maintenance kit in it also. As a soldier we bear the responsibility to reach and deliver at the destination in scheduled time. Tyres are also tubeless that does not deflate unless we reach the destination. Now we are going to start and check the tatra truck. When air is built in the truck it becomes ready to move. We have to wait till the air pressure is build up the rpm is increased to have desired air pressure. [Foreign Language Ends: 31:26]

[Foreign Language Starts: 31:51] Now we are going to ask questions, everybody regarding the use of this heavy equipment in battle. You are user of this equipment (from engineering viewpoint). Manufacturer has to understand the user needs and problems. We will ask questions from each team regarding the problem faced by you as a user. We will ask artillery, tank and tatra team in order.

Demonstration of the gun was good but you might have faced some problem regarding the use in field such as you might have expected better targeting of firing. Would you like to say something on this? Sir, we have to use this manually and modern equipment is computerized that can be controlled from a remote chamber. We need 130 manpower to handle this. That means some automation would make your job easy.

We would like to have a system that cuts down the manpower requirement. Is it possible to make an elevated fire with this? Not more than 25 degrees. More than this was not successful in the mountain area. Could you please explain the difference between 130 mm and 155 mm gun to a civilian? 155 mm it has engine fitted in it which can run up to 5 kilometers. 130 mm and 155 mm are diameters of the caliber of the gun.

What if one thinks that bigger is better and thus make big, say 200 mm? No sir, this would affect the firing range. Long range is better for us. What is difference in the accuracies of two guns? Which is more accurate? Sir, I have handled 105 and 130 guns besides 105 LFG in Kargil war, I have worked on 105 field gun that is best in mountain area. It can elevate up to 73 degrees, that makes it capable of firing over a mountain even when we are close to the mountain.

This is not possible in 130 mm gun. It have to stay away from the mountain have successful fire however 130 mm gun is more accurate. That fire round would land where we want. In 105 gun the fire becomes little inaccurate due to shock. What is duration of training required to expertise the gun operation? A new recruit is given 20 weeks basic training. Advanced training is given to the respective section after that TA provides us data, gunner mounts the round and target of the gun.

This is 24 to 43 weeks training of gunners. That means 8 to 9 months training only makes one have control over the gun. I was asking because the people who make the system should keep in mind the training duration while designing. Basic training is very important as a civilian has to learn discipline when he joins army. Normally he learns regular army discipline and language during this 20 week training. Thank you very much. Now we will talk with Armored Regiment.

You used T 72 tank. Would you like to say anything on what better is expected over regarding this tank? Sir, I have already explained the advantages of this tank but we have some limitations as well. It is a low bhp (780bhp). Just as T-90 and MBT Arjun are higher bhp tanks. T-90 is 1000 bhp ,780 bhp is comparatively low though we are using supercharge to increase the bhp. Use of turbocharger would increase it further up to 1000 bhp.

Even we can change the track design to obtain better movement just as T-90 has double track. That is made by joining two track. This makes it capable of running in desert areas, where side wind is also significant. Also tilt sensor or wind sensor may be installed (as in T-90) that calculates the wind direction and pressure, and provides this data to gunner. Use of such sensors would make it advanced. Also T-90 can fire missile. This tank cannot.



With a little modification this tank can also fire missile. We would like the scientists involved in the design of this equipment to consider our points as T-72 is used by two-third of armored units. As this tank has major application in field, we would like this to be better to achieve our mission. Simulator of this tank is available that not enough. Some field concentrate important such as braking practice, gear changing, actual speed, cruising range variations, tilt angle movement, crossing the traffic, these things are learned during ground field experience only.

This tank is of no use in night. And TIFCS is going to be fit into this. We would like this to be quick or even better system use in night. Battle is generally fought in night. This tank should have capabilities to work in night. We have to perform multiple tasks while movement such as leaning on, channelizing enemy, pivoting and destroying enemy. Tank to tank fight in enemy area considering all this, our tank if our tank is updated, we can win the battle easily.

What is training period for your tank? Total armored training is of 1.5 years. One soldier is given training in two trades: driver gunner, gunner operator or gunner driver. He is made expert in two trades. 19 week basic training and additional 19 week training on driving B-vehicle is provided. Every soldier in armored units is capable of driving B-vehicle. Then special (trade) training is provided. Movement in height, gradient or zigzag. All the things are taught.

But only this is not enough, further technical course is taught to have expertise. Even our officers are provide training to be expert in their trade. They become perfect in their trade. I would like to ask last question to you. As you were driving such a big truck, how much time does it take to load and unload a tank on tatra? It takes about 30 to 45 minutes to load a tank. It is a labor intensive job, 4 - 5 persons put the ramp on and this takes time.

Had we got lift or hydraulic system to do this, it would save time. Do you take this truck to battlefield or just unload away from battlefield? It goes everywhere. Thank you. Now we are with SATA regiment. Your technology is a bit advanced. Your job is to find enemy location and providing this information to artillery and armored regiment. What would you say regarding improvement in the system? Firstly, I would like to talk about LOROS equipment.

The cable connectivity is of year 2000 vintage when it was purchased from Israel. Power source to maximum parts of the equipment is electronic interface box. Its requirement of continuous power supply is not being fulfilled as the system is outdated. Even spares are available from Israel and only maintenance center is at Agra, India. Power back is main concern that is provided by DC supply.

The 2.5 KVA AC generator that is provided needs to be of latest technology to have good power back up. Cable connectivity can be integrated to one cable in place of current 7 - 8 cables. We have all technological jobs and the corresponding hi tech equipments, for example we have differential global positioning system DGPS that unify all the firing equipment into one control so that all can be fired at a single instant.

One more thing needs to be asked regarding DIGICORA, how does air, moisture and other parameters effect the firing? We place DIGICORA setup between gun and target, then we launch a balloon and send a radio sounding to firing environment. Pressure, temperature and moisture conditions; this data has two hours validity. This data is transferred to gun and also print outs are obtained. Five different messages are rectified from this data.

This is the machine known as radio sounding that has pressure, temperature and moisture sensors in it. This is its UHF antenna. It is launched in space with gun. We transfer the weather information to the guns which are ready for firing. Exact data is obtained at every 2 hours and we apply that. Finally, I would like to say something to all of you. You all have same opinion and I would like to say to my course students that consider the user concerns while system development.

The who uses in the field, his requirements should be fulfilled using engineering skills. After watching this, my course student would have a feel about user requirements. You need and requirements should be accessible to developers, and the system should be designed accordingly. The best possible system should be made. On the behalf of all the faculty, staff and students I would like say a big thank you to all of you. [Foreign Language Ends: 50:35]

Because this probably the first time people get to see a real life demonstration about all this things. It was been a great job you guys have. You guys all look great in your uniform and your battle dress, and you all know that. Like sir we say that if we are competing with the US, with the America, with Russia, all the developed nations sir in different place of life right sir. In the business side business studies, we can say that all the important scientists, all the doctors, who are in America are from India only (()) (51:08) we can say.

And then we have competing with those high developed nations, in the same way we have to see in our defense sector also. there is we have to employ those of the machine or the technology as compared to them that is whatever they have, they have to develop all the things but we are using all the vintage kind of machinery technology. So at this platform, that is IIT, Kanpur or different institutes like when we are standing the pinnacle of perfection.

We can say that sir those things all the people over here their concepts can be implied in the army and then the things can be improved a lot extent. So that we can be able to compete with them also. Exactly, In terms is of defense sectors also. And also that would - [Foreign Language Starts: 51:50] On that regard also in the concluding remark you know, it is great thanks and a salute for all of you guys for doing this. Thank you very much and jai hind.

[Foreign Language Starts: 52:13] Victory for mother India, Victory for mother India, Victory for mother India [Foreign Language Ends: 52:19] Thank you. [Foreign Language Starts: 52:20] This is KrAZ 255A. It is a Russian truck. Two 12V batteries are required to start this truck. It has 6-cylinder engine. It has 6 wheels that work together. This make it move through difficult terrains. It has diesel tanks on both sides with 160 litres capacity each (total 320 litres).

This is engine radiator. It has left hand drive. To start, battery is switched on. This is its base. We have Brizter inside. Sir, this truck seems to be little old. This 1993 model as the number indicates. As you know about the numbering system, could you explain please? First we have model number 93 (year 1993) in thus case, after that is registration number just as it is there in civil vehicles. I have question.

Why the wheels of all the trucks here too big? Sir, big wheels do not stick anywhere and keep the vehicle moving. Small wheels may have stuck in bog and may keep rotating at one place. You have vast experience in driving this vehicle, could you suggest any change to make the truck better? We have some problem in steering that does not turn everywhere. Had we got power steering like it is available in other trucks models, it would be easy to turn this truck in small turning radius. Then we can take this truck to any place. Thank you. [Foreign Language Ends: 55:56]