Water Supply Engineering
Prof. Manoj Kumar Tiwari
School of Water Resources, IIT - Kharagpur

Module No # 11
Lecture No # 57
Examples of Automation and smart water supply systems

Hi friends and welcome back. So we are in the last lecture for week 11 and this week we have had discussion on the automation in water supply and the concept of smart water supply system. So we discuss about what is, smart water supply systems then we did talk about the smart sensors and meters which are very key component of a smart water supply system. And then in last class we did talk about the automation systems like SCADA which are another very prime component for the smart supply systems because they are the one sensors help us in collecting the data.

So they make a pillar in the form of that they make information available and then we this data goes to a smart system which can analyze and make decision based on the data and communicate back to the tools which can perform those actions in the field. So collecting data is very essential and so is the analyzing that data for making the real time decision or near real time decision ok. So, that part is taken care by the system like SCADA which of course integrates the sensors and these things for collection of the data and then through PLC programming languages and through those things it kind to the software's.

It analyzed that data and under certain situations as has been guided it comes with the set of decision which are communicated to the on field sensors or on field tools which can deploy or which can perform those actions which are communicated from the central. So this particular class we are going to see some examples of how automation, systems has been used in the different aspects of water supply services.

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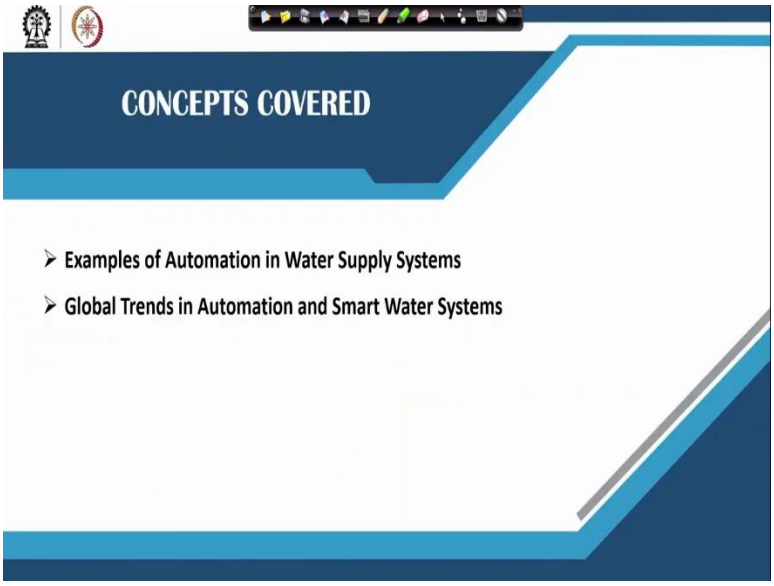

So we are going to see the example of automation in water supply systems and we are going to see from trends global trends in the automation and smart water supply systems.

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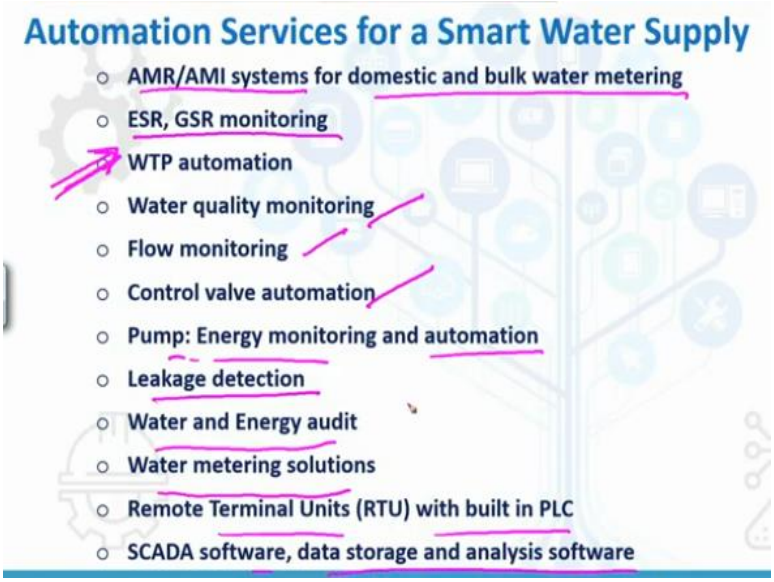

So the automation services for a smart water supply system can include so many things we already have discussed this but just a quick over view that they can use the AMR or AMI systems for the domestic and bulk water metering. They can be used for the elevated or ground storage reservoirs. They can be used for the water treatment plant automation. This is by far one of the most popular use of the automation systems in the in the water supply sector.

Then water quality monitoring, flow monitoring, control valve automation. So automation of the control valve will lead to the like automatic operation of the control valve. And which rely on the communication through the server then operation and monitoring of the pump. So energy monitoring and the automation, the leakage detection can be used using this automated systems. Then water and energy audit can be performed the metering solutions can be obtained then the remote terminal units can be operated with built in PLC and the SCADA software data storage and analysis software's are basically to be operated using these features.

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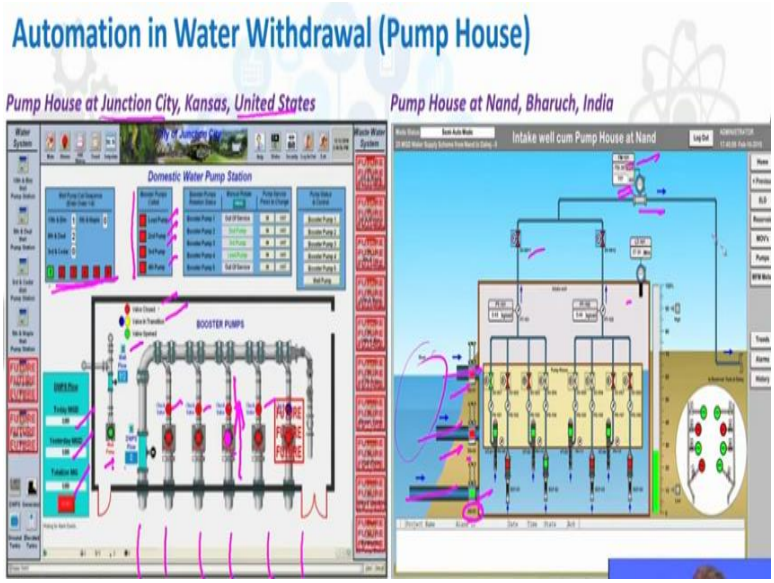

So we are going to see some examples of the automation systems okay this is for example the automation in the water withdrawal. So we may have pumping systems so like for example say this is the in the Junction City in Kansas United States. So let us say you have several ground water wells and then architecture can be built on a HMI interface or your computer interface which will be basically showing the all the different pipes and then there are say these are check valves.

The red means they are closed, green means they are open. So, this is the pump well which can be pumping. So we can get a display of this particular type ok it is just an example in fact there are n numbers of ways through which that displays can be designed ok but this is for an example. So it will be basically like saying that red means valve closed, yellow means valve in transition, green means valve open.

So all these operations can be achieved and if you see let say level falling some where you can you may have say these buttons or operations you can basically guide this to let say you want to this valve to remain open. This pump to kind of work on so it will start pumping water while these others are closed. So all those kind of control feature can be obtained ok. It will provide all other necessary information like today how much million gallons water has been pumped what was the amount yesterday?

What is the totalizer for say month or year depending on how we set that ok. These are the booster pump lead pump so like the lead pump first pump, second pump, third pump ok. These are the well pump so like one well first well pump is on whereas all other well pumps are off ok. So they have in the red these are booster pump so again how they are operating so all these things can be integrated on a screen and a complete control can be opted.

These are another example for the pump house at the Nand Bharuch India. So say this is our reservoir or river. So from river water is coming in here ok you can have a display system like this. So let us say you have 1, 2, 3, 4, 5, 6, 7, 8 so 8 kind of systems over here it pumps now. You can switch on switch off these based on whatever you are how you are operating or set up an alternate cycle in case of emergency you can switch on more and you can basically see ok.

This is say this is green this is working and what is the flow coming here will be displayed this is red stopped so far if there has been any flow. So whatever like we can have an option or setting up the design setting of this architecture that how we are want to oversee this ok. So like if you have a flow meter so what is the value what is the total value pass? What is the flow rate and what is the volume which has been passed in a day then the operations of value whether it is on off all things can be controlled and seen here?

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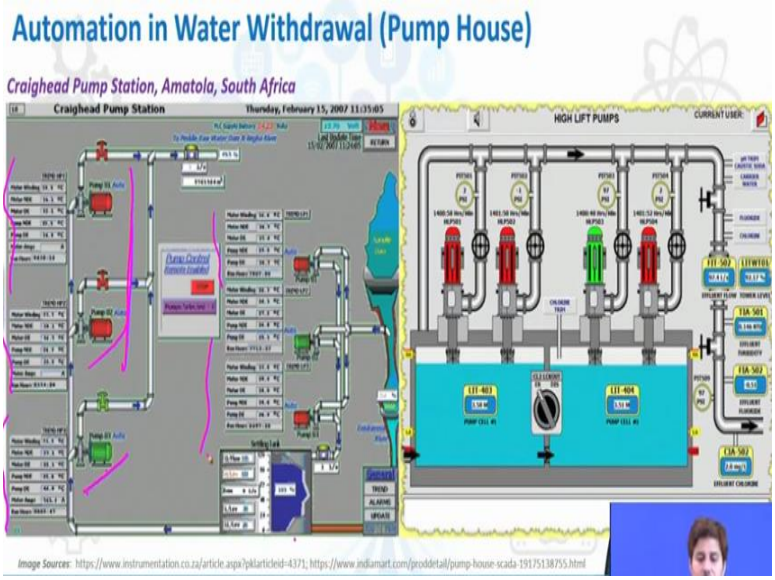

So this just an example ok we can see several like other architecture similar other architecture for the pump house. For Say this is an example from the Amatola South Africa again you have a pumping system from this thing so you have say 2 pumps as you can see are red. So they are not running the third one is running all the pump parameters or features can also be displayed.

So depending on how we are going to design what how much information we want to see on the screen we can set up this architecture ok. So these are the say example that are there from the pump house ok.

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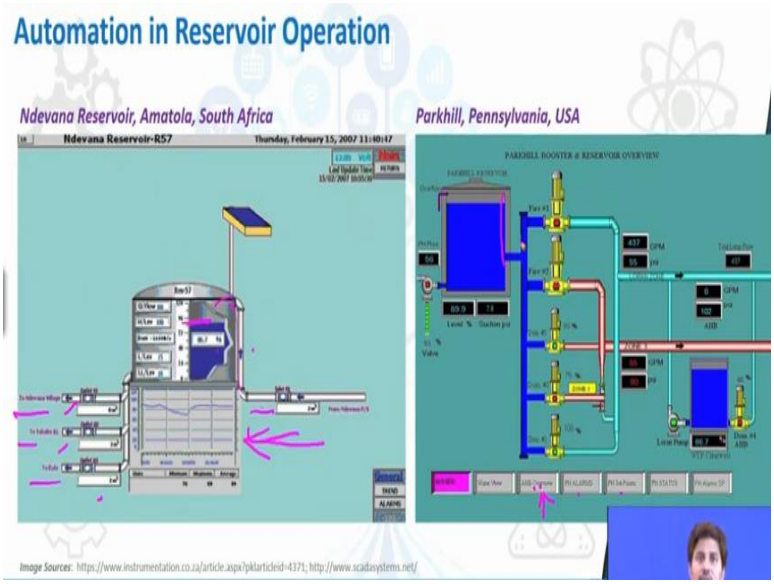

This is automation in the reservoir operations ok. So in reservoir operation again this is from the Ndevana reservoir you may have a say reservoir then you can monitor the level what is the level here you can see the operation of the pumps whether they are running whether they are closed how they are feeding. If they are feeding the reservoir what rate they are feeding if reservoir is losing the water, why or let say this is the feeding the reservoir this is in flow.

So how it is how much it is feeding what rate the reservoir is getting water upon these are outflow. If all 3 are open one is open to close means which one is open which is closed. So, all those features or operations can be seen right in a like very clear way ok through an HMI or through a desktop system. And then that is about the display of the information and of course there are options so like you may have buttons over here.

So you can touch on those buttons to control also. So let say you want to close down certain pump you have feature to do that you can basically close that pump sitting right in front of the screen through a command you can shut off a valve, you can shut off a pump or you can basically start a pump you can open a valve. All those control features can also be obtained. And you can monitor the levels in the reservoir you can see ok what is the level what is the existing level in the reservoir how much water has gone in the reservoir in a day.

How much water has left reservoir in a day with the help of the data or the display which is there you can do the mass balancing of the reservoir as well. So all such like analysis is very much feasible with these kind of systems. So the operations for reservoir, is mostly in the level sensing and the pump house operation. So like if you are sensing the level in the reservoir and if you see that like levels are not appropriate you can switch on the pump in order to fill the reservoir or generally like it may have automated protocol that once the level falls below a certain level the pump will automatically start and it will start filling the reservoir.

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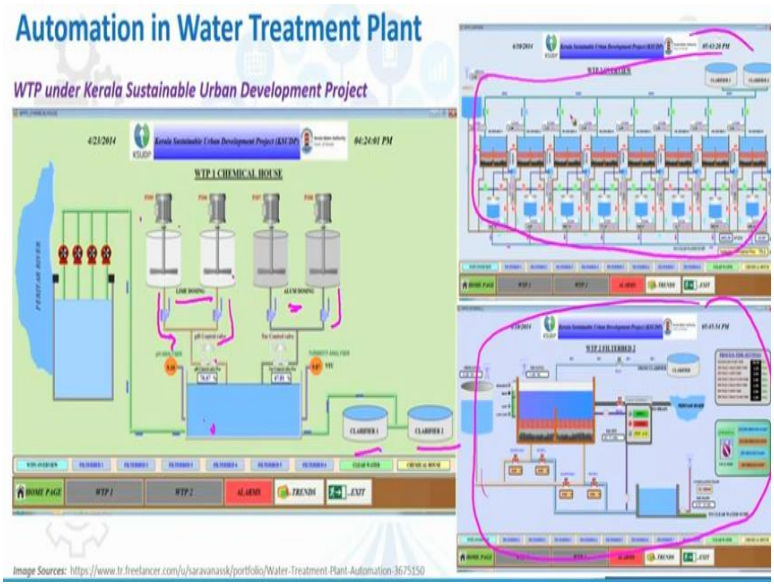

This is an example of the automation in a water treatment plant. Now as we were just discussing that it in fact water treatment plant is a unit where or is a system where automation is very much feasible and that is why it is very highly used ok. So this is an example kind of system you can say that the lime dosing. So you have basically pump or the mixer for the dose you can add and then from here you can control the flow rate through which lime will be the dosage ok.

So you can have pH detection systems it is in control pH based on the pH you can decide on the lime, you can decide on the alum dosing and then everything comes in here. So this will be mixed ok and then it will goes to a kind of clarifier so what are the levels in the clarify? How they clarifiers are operating? All such information can be seen. So in a water treatment plant like again this is a say for example for the filter bed.

So water from the clarifier is coming in here it is basically being fed to the filter bed. How the bed is operating? What level the water is there in the bed, the quality of the water which is coming out? Then the wash water collection which process is running on whether it is normal run process or the backwash process that is like we can say detail of one particular filter or we can say that in fact we can have a summary of the entire filtration assembly as well. So where we can see how the different filter beds are performing ok.

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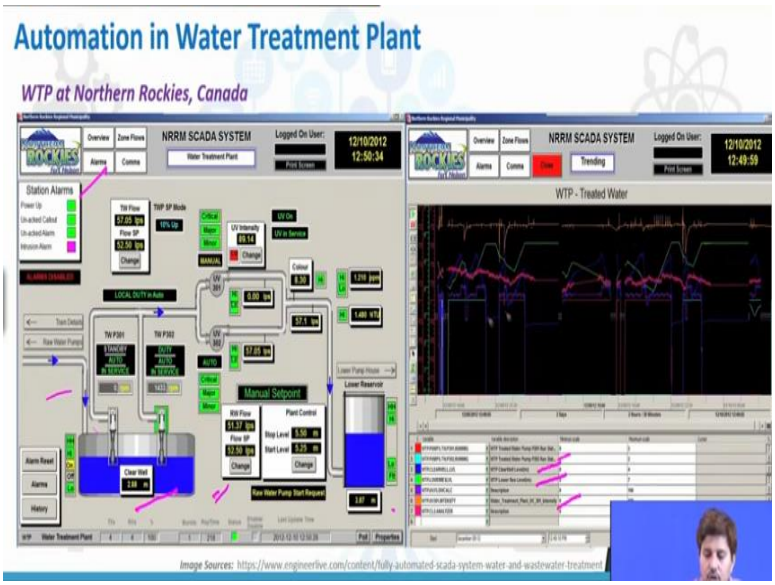

The role of the SCADA in particularly water treatment plant is very wide in a sense that it can like almost cover all the steps that are needed in a treatment plant right from the flow monitoring the screen operations if there are any screen ok. If there are aerator so or diffuser or those kinds of things so when to switch on that when to switch off that what are the full control of that the dose estimation based on the water quality parameter?

This is one of the very kind of nice feature that you can estimate the dose and based on that estimated dose you can program it to be basically dose the system appropriately ok. So the chemical dosing appropriate chemical dosing then the process of the settlement, the sludge monitoring sludge going into the like through what rate of flow sludge is coming out through centrifugation.

How much solid content or water content is changing in the sludge. Then it is going to drying bed for how long it is say on trying bed or if you are using advanced processed like the filter press or filter those kind of process for sludge management. So the performance of those process how much pressure is it is applying? How much water is excuse out? It means how much water has come out of that sludge.

So, all in connection actually can get us an idea of about the sludge management then clariflocculator part then your filtration part and chlorine dosing similarly ok. So for based on the residual chlorine available in the system it can decide upon like the chlorine can also be

monitored through sensors. So it can monitor the level of chlorine present in the sensors and then how much chlorine needs to be added in order to get the desired level of residual chlorine.

So, all such operations can be automated at a water treatment plant. There is another example of the norther rocky plant in the Canada ok. So this is basically say it can station the alarms power and checked all that. Then water going in here this is the clear well it is going then for other various process how it is being pumped ok. And we can monitor certain like we can monitor the performance of various stuff. These record in terms of like what is the UV intensity?

What is the like lower residual level? What is the clear water reservoir level? So real time monitoring of all these features which are being determine using the sensors. So they all can be monitored and displayed upon.

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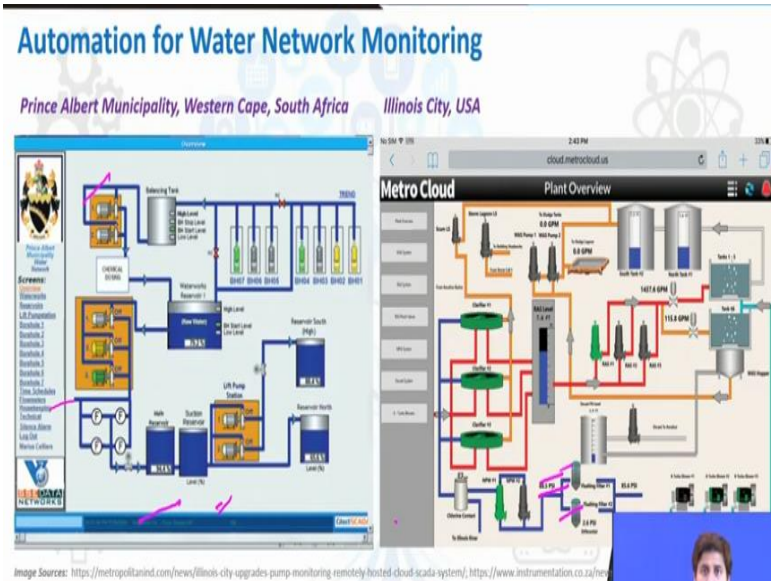

Now another sector where this can be applied in water systems is the water distribution ok. So for the purpose of water network monitoring which is very similar to like again the processes more or less remain similar for all such cases ok. We may have like in a distribution process what we will need will be needing the reservoirs ok. So like what are the; we may have several placing of the elevated reservoir so what are the water level in the reservoir what is the we can control the pump house or pumping stations using SCADA systems.

Similar like we do in our water abstraction or pump house for water withdrawal we can use we can guide monitor pumping based on the reservoir level in the distribution system as well. At the reservoir we can monitor the pressure not reservoir in the distribution system we can monitor the pressures in the distribution the system we can monitor the treated water quality residual chlorine level like if you see there in the distribution system if you see that residual chlorine level falls somewhere it will automatically give the alarm to the system and it note that ok.

So probably the residual chlorine addition is not adequate. So the enhanced dose of chlorine may be provided at the treatment level itself. So that the appropriate amount of residual chlorine stays in the water by the time it is delivered to the consumer ok. So the levels in the various storage reservoirs the water quality the pressure, the flow rates all actually can be monitored and can be controlled or computed in the using the this kind of SCADA tools.

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This is just another example of automation in the water distribution systems. So now like based on these examples that we see it is actually like if we see the worldwide so most of the cities in the developed countries have fully or partially automated their water treatment facility. If you see a particularly a water treatment facility almost like make most of the places in the developed world it is automated.

In India also in quite a few treatment plant like in several treatment plants as well as waste water treatment plants these SCADA has been adopted and these systems has been fully or to some for

some cases it is in fact partially automated ok. Why it is so popular in the treatment systems because first thing a treatment plant the reason is limited. You have a say confined boundary where you are having all the treatment units.

So you can go for sort of setting up an architectures setting up unit monitoring station everything within that particular confined unit which is easy to set up ok. You can set it up and treatment plant require lot of monitoring and control much more than that in the distribution system or raw water system. Raw water system you will just monitor the flow pressure and maybe the some water quality parameters once.

Whereas in treatment plant you should monitor the flow at several stages like ok what is the flow going into a one particular unit then what is the coming out then what is going to the other particular unit? What is the backwash flow rate? What is the velocity? Then the water quality parameters can also be monitored at several stages the inflow then say if you are using a clariflocculator so what is the quality after clariflocculator? Then what is the quality after filtration? What is the quality level after the disinfection process?

So starting from raw water quality there is a like huge scope of monitoring water quality at several stages huge scope of monitoring flow and losses and other stuff pressure drops at several stages. So all like there is a lot to be monitored and lot to be controlled also. You have to control the flow in the different steps you have to control the pump backwash operation. You have to control the sludge collections operations sludge drying or sludge processing operations.

You have to control the chemical feeding operations, dosing operations then running of the like mixtures or the aeration systems. So all in all there is a lot of process that needs control and monitoring in a treatment facility and they are all confined in a particular area. So it provides good scope for using automation system. Whereas in distribution system what happens because distribution systems are very wide if you try to say put a SCADA system for say a city like Kolkata or Delhi, Bombay ok are even a part of city say ok forget about the complete city.

Even a part of city still like the network are far off places so you have to basically put in sensor at far many places and then what you are going to monitor? You are going to monitor the treated water quality at few places. You do not expect water quality to change in the distribution system

that much ok as you expect in the water treatment systems at several before and after several units. So there you do not expect much so a few monitoring station for water quality then pressure station and a flow station. So that is what practically you are going to monitor.

And because of the widespread network the requirement of if you want to go for a fully automated system the requirement of the sensors or the infrastructure is so large that it is usually not done in the distribution system. So automation in the distribution system is only at few places and that too is mostly limited to monitoring the flow and pressure in the bulk flow meters reservoir level sensing and pump house operations.

It does not monitor flow in each and every pipe for each and every household connections ok not even all the sub mains. So it is just like with at generally at some places some keep notes keep places pressure is monitored. Some key places flow is monitored, and levels is monitored in all the ESR and where there are booster pump or say other pumping stations. So they are like monitored and controlled using the SCADA system.

The fully automation of the distribution system is nowhere in India and probably nowhere in the world also for a complete city level ok. It is just that the smart grid systems with complete automation are still under trial and testing stage even in the most developed cities across the world ok. There are very few like a small sector where they have been implemented to some extent like much wider sensing is available.

You may have a sensor for each and every branch or known pipe everything but to going to a household level or the end consumer level sensing is still not achieved that way ok. So that is why in India also we have like water treatment and wastewater treatment plants in many cities have been automated but the distribution system not. Distribution system have been automated but again to only a partial scale where we just we were talking we collect the flow pressure and some reservoir level sensing and pump house operation that is what is being achieved. The consumer level sensing we have not been able to achieve here ok.

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Now if we see the overall global trends in the smart water grid technologies. So, globally many utilities are talking about going for a smart water infrastructure. They are aiming to move to the smart water infrastructure. However, only few have had some success in establishing a new water management infrastructure with smart grid technologies ok. The 2 leaders there in the work are the east coast Queensland water grid system from Australia and then PUB Singapore system ok.

Water supply network department of Singapore so, that also has been able to demonstrate some smart sensing ok. There are number of new projects and proposal which are being considered or being attempted aiming at smart water grid technologies ok. Some of the known projects are like in India there has been a lot of talks about this smart cities. And some of the smart cities particularly the one which are going to be newly design ok they are aiming for smart water grids ok.

Then there is a popular smart water grid project funded by the Korean ministry of land infrastructure and transport. That is another like project which is going on. And in US there is very ambitious project on the national smart water grid which basically aims to alleviate the water scarcity problems in the Midwest of the USA. So these are some of the popular projects but still mostly in the like being consider or tempted but the full scale demonstration is still not achieved in many places. So these are some of the cases or like in the different countries how the trend is being set up.

So with this is we will conclude the discussion for this week where we have talked about the automation and smart systems in water supply sector ok. Starting from the raw water pumping to the water treatment to the distribution systems and how in an integrated way like the concept is there the knowledge is there but implementation is still a very challenging task. So we will have to see with the progress of time where we land up how we are able to implement these concepts in the field and to what scale?

Because one of the like all the systems are pretty good very sound very good but of course there are certain issue comes all the systems all these kind of systems are costly. So there is a huge financial footprint of adopting these systems and we have to see how much benefit we extract out of that whether they are financially viable or sustainable that needs to be seen ok. And there has to be like user awareness for successful of these systems.

So user has to be aware that what kind of system is being followed how to perform or how to behave in certain situations? So all those like the user end integration into the designing and developing of these systems is also essential for the successful of these operations. So anyway, like the concepts we have seen, and we will see where we go from here. So thank you for joining and we conclude the discussion in this for the week 11 here. We will start discussing about the economy and pricing aspect of water in the next week's discussion. So see you next week thank you for joining.