Water Supply Engineering
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Module No # 11
Lecture No # 54
Concept of Smart Water Supply Systems

Hi friends and welcome to the eleventh week for this course water supply engineering. So earlier week we have been discussing about some of the recent features which are being employed to kind of making an upgraded water supply system. We did talk about the concept like 24 7 system. We did talk about the concepts on the use of various advanced softwares for designing and analysis of the network.

This week we will be talking about the automation in water supply systems and what eventually leads to these smart water supply systems. So this particular class we will be discussing the concept of smart water supply systems.

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What we are going to cover is the basic introduction on the smart water supply systems. We will talk about the various features of the smart water supply systems. Then we will discuss the objectives and the various elements of smart water supply systems and some of the technological solutions which are available for smart water supply system.

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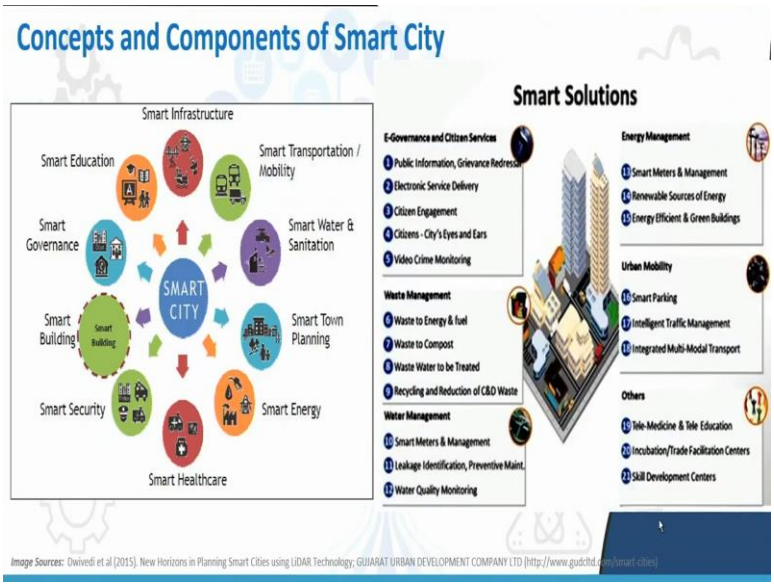

So as not only India but worldwide basically there is a concept of smart city getting more popularized it is more popular in the west where many cities are being planned, designed or being converted into the smart city concept. In India the concept is still in fancy our union government is pushing for development of several smart cities most of them are actually the older cities being plan to converted into the smart cities.

And they there has been basically 2 rounds of identification of the various cities in towns as in smart city. There are some new city planning also taking place and the newer cities are easy to basically planned and design as a smart city. Whereas with the older or existing infrastructure it becomes sometimes quite complicated to convert an existing infrastructure into a new infrastructure because that eventually become more costly rather than going for a completely new system because you have a system in place.

So that if that is not well you have to basically dismantle and remove that system so that requires additional cost. And if there are population existing already there in the city there are so many people living and removing an infrastructure cutting of their supplies for various utilities becomes very challenging. So in smart infrastructure for smart cities we have various components like smart education, smart governance, buildings, security, healthcare, energy, town planning and one of the component is smart water and sanitation.

So what we are going to focus on this way okay and practically like this is basically from the Gujarat urban development company and if you see so under the smart solution. So there is a e-governance, the waste management, water management, urban mobility which is basically transport related mainly energy management and various other things. So in water management there is a smart meter and management leakage identification prevention and maintenance and water quality monitoring.

So these are the 3 major points which have been identified as a key for the smart water management and overall smart water and sanitation is one of the very important components of an overall smart city ok.

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So when we say about the water management part ok or rather smart water management part we have to see from which level we are aiming to be smart. So what is the conventional management approach? What is the conventional system and what are the issue with that and that will give us an idea what we need to overcome in order to achieve that smart status for the water supply? So generally, traditionally water supply operations are conventionally managed by the skilled semi-skilled or even at times unskilled human resources ok.

The operative practices mostly rely on the experience of operators and managers. So like you can see this as an example in a city for how much water is to be supplied. So they have made a kind of thumb rule ok you open valve say 30 rounds or 40 rounds opening and you keep it open for

about 2 hours ok. So all this kind of practices are there which relies on experience that if you open it and for say these many rounds these many circles it will have approximately this flow running for 2 hours. So this can basically cater this much of demand.

Similarly pump operation you start pump from this time to that time. So nobody kind of checks what is the level in the reservoir? If the level in the reservoir is already full and you are running pump. So it is going to like unnecessary create extra pressure on the reservoir or store more water than requiring that is puts more water in the reservoir than required ok. Many times even if the reservoir is empty people have consume more water.

But it is not system is not running or more water is not being pumped to the ESR and then people of to face that no water in their taps or in their homes and many times they will call the utility that though there is no water here and so that kind of situation also takes place. So; mostly it basically done on a completely ad-hoc basis ok. So whosever decides that ok let us run from this time to that time or open this many times open this valve close that valve particular run a pump at this speed put a pump.

So many things actually work on an ad-hoc basis and they mostly rely on the experience of the operators and managers. Whereas if you see about the monitoring purpose or monitoring subs so monitoring and the mains or the consumes end or the basically reservoir level monitoring, valve operations, pipe cracks, bursts, leak detections, water quality monitoring etc., are all very difficult to achieve in this kind of systems at frequent time scale.

So if you do not have a any good technological support like we have a meter then who is going to go daily there or weekly there to read that meter ok. You may have even if you have a meter ok. And then if you have a valve so valve operation like you manually somebody has to do these and this like opening these kind of valve require lot of power and energy. So many of these operation like the water quality monitoring is so difficult how you are going to grab sample bring it to lab analyze it get report.

So these are all very tedious processes and as a result overall operation monitoring is grossly inefficient with these traditional practices of monitoring and management ok. As, we have been discussing particularly the water losses. So estimation of losses leakage where it is happening if

there is no proper practice in place it becomes very difficult to estimate or assess these kind of losses.

So overall like management of the infrastructure and particularly if the infrastructure is aging which is the case in a various older cities. The infrastructure has been installed several decades ago 30 year, 40 year, 50 year, 60 year old infrastructure is still running at various places okay. So then it becomes kind of grossly inefficient with traditional practices to monitor and management these kind of systems. And this calls for the recent technological advancement to kind of propose or offer a solution to these issues. So this is what is about the existing scenarios.

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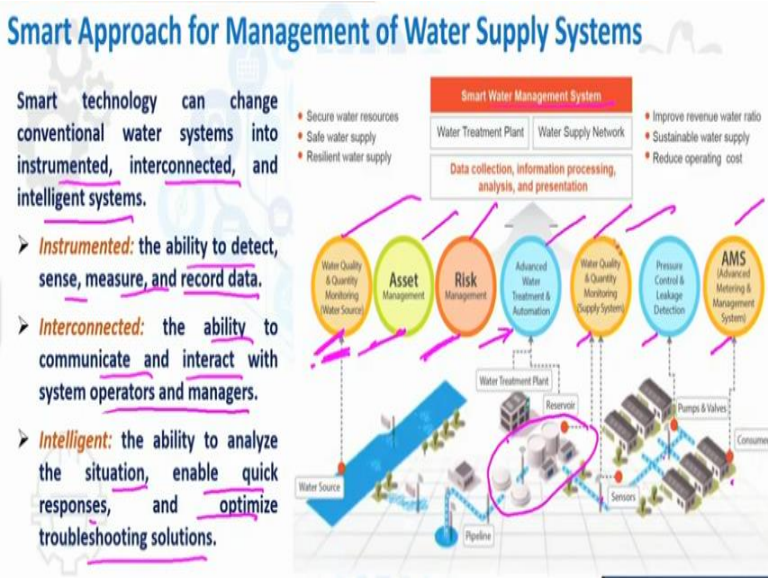

Now then what is this smart approach for managing of the water supply system okay? What we are going to discuss is basically it is a practice should be adopted to change that conventional approaches which are being adopted for managing water supply infrastructure ok. So it kind of makes system the instrumented, interconnected and intelligent. Instrumented means there should be ability to detect sense and measure and record data various data should be recorded ok.

Interconnected means there should be the ability to communicate and interconnect with the system operators and managers. So the data recording and data communication and then intelligent relies on the ability to analyze the situation enable quick response and optimize trouble shooting solution. So this helps in a kind of decision making. So that eventual point is

that in a management of the utility we should go more on to the experienced based or ad-hoc decision making to more informed and intelligent decision making.

And for that we need data and the smart these smart water supply systems mostly relies on that data which is being collected okay. So the features if you like if you see there is water quality and quantity monitoring has to be there. There has to be aspect of asset management there has to be a domain of risk management and then advanced water treatment and automation. So like whatever treatment is being proposed and that treatment process should also be kind can also be automated even in the treatment scale if you see.

So water flowing from one unit to another unit from filters so or like to what level filters to be operate when exactly is the time to backwash or similarly for coagulation flocculation. So to what time run what is the dose of Coughlin which should be added what is the existing entity. So various other things are there which should be which can be done in a more smarter way like somebody is measuring or calculating the amount of alum doses needed.

And then putting it into the rapid mixer and that other alternate or smarter system could be based on the water inflow coming it automatically detects the quality of the water the turbidity of the water, the eternity of the water system computes the doses of alum and from a stocks storage of the alum it decides how much alum is to be mixed. And that much alum doses into the rapid mixer. So job is done.

No human intervention no kind of decision making ok let us add 20 kg alum even if the requirement is say that particular day requirement is say just 16 kg you might end up adding it 18 kg 20 kg alum. Or requirement is say higher 24 kg and you just add 20 kg alum and then you get a inferior quality inferior quality of the treated water ok. So with adhoc decisions or experience based decision this is what happens until unless the proper monitoring data and inform decision making comes in the place.

So the smarter system mostly rely on putting up a intelligent decision which is based on the information or in the form of data collected at several at different stages. Then water quality and quantity monitoring in the supply and then kind of pressure control and leakage detection in the supply and then advanced metering and management system.

So these are the major kind of domains which are there which are the major components of the smart water supply infrastructure or smart water supply system which relies from monitoring level before and after treatment ok to the asset management risk management then advanced metering and monitoring at the end level the treatment process and quality monitoring process so all are integrated and into a much larger or broader system.

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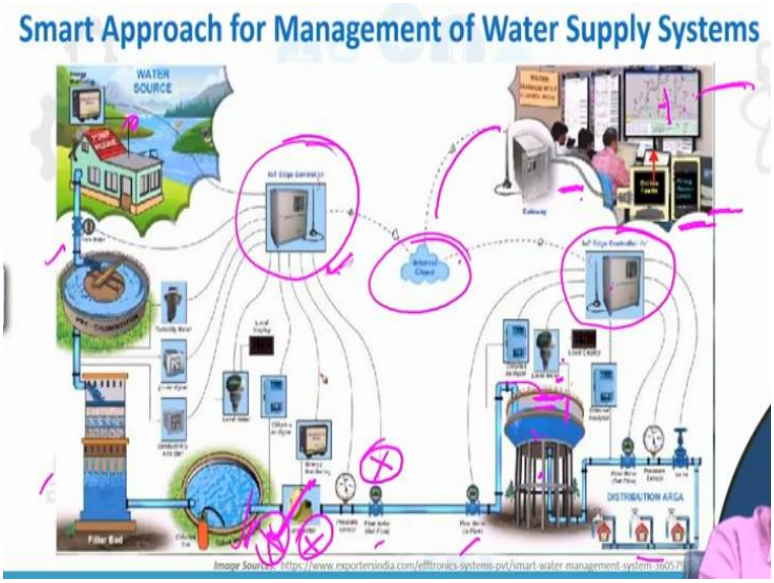

So if you see this smart approach for management of the water supply system as just we were discussing. So we can see here that you have a source water you have to have a monitoring there which needs to be basically go to s IoT age controller. So this is advanced system which kind of gets data from everywhere and assemble and process there has to be a say flow meter then this is your filter bed other options clariflocculator or chlorination ok.

So you do chlorination over here then you are pumping it. So all thing eventually is communicating with a system which kind of is assembling and getting all the data ok. And this could be done through directly wired system or could be done through internet cloud and then after treatment again there would be flow meters it will be going to a storage reservoir or service reservoir and then from service reservoir it goes to the distribution area.

So everything basically again gets to a controller and then internet of things based controller or ICT based systems will put it into the cloud and then this is communicated to a major server

room where all the data is information all the data and information is collected analyzed and processed and decision making might be taken there or and can be communicated back because this could be a 2 way communication as well.

So decision making might be taken there and can be communicated back to these features. Let us say like as if somebody is monitoring the system you see there is a problem in this particular pipe he can instruct this say this valve to remain closed ok or this motor too remain closed ok. If there is a shortfall in the ESR he sees that the ESR is getting empty it is not filling the demand.

Then you can instruct that ok you run this pump feed the chlorinated water into that ESR. So that kind of like decision making can also come from here which can be communicated back ok or many times there are automated decision making as well in a more smarter system. So where you do not need any person to kind of oversee this and make a decision it could be a system integrated when basically it sees that ok a water level in ESR has fall this it will ring an alarm or it will kind of give a signal to this things to run to start the pump.

And so that ESR level reached at a adequate level. Once it reaches adequate level again it detects the level there would be a level sensor here would be which would be detecting. So this is your say level sensor it will detect it will communicate and then it will go to the server and from server it will come to the again information will come that ok now close this pump. So, all this kind of features can be there in a smart system.

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So practically if you see major aspects or major features of a smart water supply system. So this have this is basically intend to have a improved efficiency longevity and reliability of the underlying physical water network. So whatever the network is that way it can be basically more efficiently managed more reliably managed and it could be actually run for much longer time. And we can achieve these things by better measuring, collection, analyzing and acting upon a wide range of network event.

Whatever is happening in the system so as just we were giving example that if you are having a proper level maintenance in a ESR versus another system where some time it runs completely dries sometime it overflow. So of course, it will reduce the life of the ESR as well and the operation and effectivity of the ESR. So, this can take basically in a different phases in a basically real through real time monitoring and automation through operational readiness and through network planning ok.

So overall if you see the idea is to measure smarter so all the parameters are measured in a better way in a smarter way communicate better the whatever data is collected is communicated ok not relying upon those manual communication it has to be kind of a smart communication so that it reaches to the data center in a near real time. Then analyze easier so there has to be a soft computing system which analyze the data which receives ok.

So analyze display mechanism all those things as to be in place then improve revenue. So if things are being processed so the billing system the revenue collection system all that has to be

proper and if utility is improving on revenue collection so it might have surplus funds through kind of further upgrade and improve the efficiency. So that will need to increased efficiency of the utility overall utility. So these become like the important aspect or features for a smart water supply systems.

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So essentially a smart water network is kind of an integrated set of products or solutions and systems which enables utility to remotely and continuously monitor and diagnose problems. It also helps in prioritizing and kind of managing the various issues that are coming in with the utility and use the data to optimize all us kind of all the aspects of the water distribution network okay.

The so starting from the quality quantity leakage level monitoring everything to the transmission issues ok how it is happening we have to have the water meters inappropriate then treatment issues then pumping or storage issues and then distribution issues and all that information should be available at a common user interface as well ok. So that is the other user end stakeholders are also available about the running of the utilities ok the functionary or the roles responsibilities reliabilities.

This would also help in fact the utility to build a rapport with the end users. So that way they smarter systems help in kind of majorly diagnose problem prioritizing and managing the

maintenance issues and optimizing all aspects of the water distribution network. So this is the kind of major point or major benefit out of this smart water networks.

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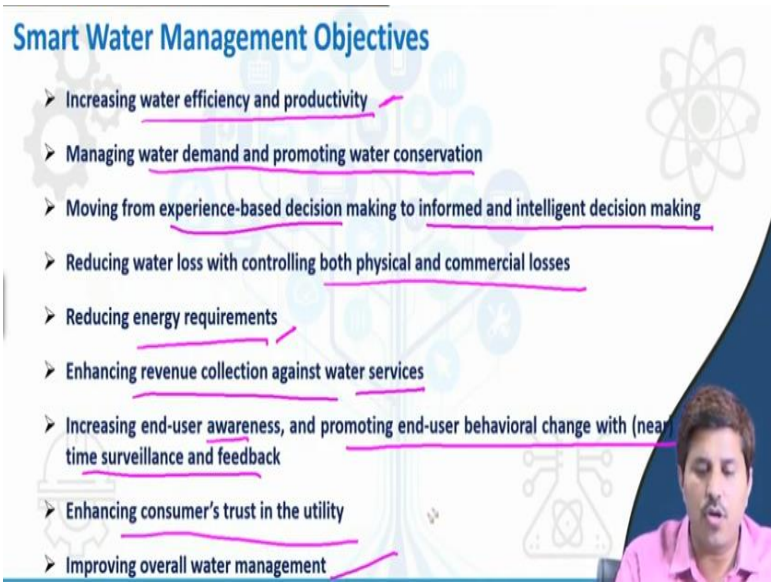

Now what essentially is targeted what are the objectives of going smart for the water management purpose? So the major objective is the increasing water efficiency and productivity because with the conventional system there is lot of water losses a lot of water theft and other issues. So we like with a smarter system if those things are cut down and then water efficiency and water productivity might be increased. So that is one of the prime objectives of going for the advanced technologies or smarter technologies for water management.

Again it aims to managing water demand and promoting water conservation okay. So the smarter functions helps basically if you are having a public dissemination system or like everybody being aware of how much water they are consuming? How they are consuming your meter is kind of displaying this things and it gives an idea of the average and how above or below average a particular household is ok so that kind of provisions and of course there has to be tariffs.

So if somebody is using higher water so he is paying higher amounts. So this kind of proper management and maintenance of the utilities helps in managing water demand as well. So people will realize ok I am using lot like if you see that ok the average consumption is far lesser than that is being consumed in my household. So I know that there is a potential to cut down my

water consumption. So in that way it can help in managing demand ok and promoting the water conservation as well.

Further next point is moving from experience base decision making to informed and intelligent making. So this is one of the very important objective of going smart because if we do not collect the data or collect the information we do not have a proper maintenance and management system in place. Then as we see in most of the cases particularly in the Indian cities in most of the Indian cities now that the decision making are more ad-hoc kind of experience based decisions.

Whereas there is a need to be more informed and intelligent decision making we were just discussing couple of examples earlier like the ESR level when to when to switch on the pump when to switch off the pump or say chemical dosing into a treatment systems. So how much to be added whether we are dosing it like we are overdosing it or under dosing it. So those kinds of things can come with a informed and intelligent decision making. Where we know what is the data of based on which that decision has to be made ok.

So if we know that data if we know that ESR level data it gives us a better decision making in terms of the operation of pump if we know the input turbidity and quality water quality so that helps us in decision making about the selection of the treatment processes or dosing of the chemicals. Then it reducing water loses with controlling both physical and commercial losses.

So smarter system or a more watertight system can help in this we do are just discussing in the earlier week about the concept of 24 7 systems or the concept of like marking DMA wise water loss assessment control and management. So those are another features which helps in there. The reducing energy requirement with this water losses there is a lot of energy associated. So it can help in reducing energy requirement as well if the system is better management.

Then enhancing revenue collections against water services, we were just discussing that with proper data meters billings systems there is a possibility to enhance revenue collection as well. So if utility is not able to collect the revenue properly this kind of system will help in the revenue generation or revenue collection as well. Increasing end user awareness and promoting end user behavioral changes which with the near real time surveillance and feedback.

So if user is informed about what are their consumption? What are their like how what are their demand patterns so there might be a possibility to leading of the behavioral changes? So there has to be by kind of made aware with the timely surveillance and feedback and that kind of things can be achieved with the smart water management systems. Then enhancing consumers trust in the utility and improving overall water management. So these are some of the other objectives with which we go for the smarter water supply system.

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Now the elements that has to be there in a smart water supply system are basically the technology based effective solutions and these are smart meters and sensors. So these are basically the communication enabled water meters, pressure gauges water quality sensors who can real time monitor the characteristic transmitted. Transmission would be through smart communication systems.

So it has to have a smart communication system where information and communication technology like ICT or internet of things IoT for wireless data and command communication and transmission would be useful. Then smart decision making which is basically the soft computing tools for data analysis and decision making. So whatever information is coming how we analyze that and what kind of decision it triggers.

So basically the informed decision making or smart decision making would be another component. Then smart control system so these are like SCADA kind of system supervisory

controls systems which are based on the data processed or the decisions that have been made. So there like if you get a decision that you run this pump so there as to be a control systems which start running that pump or you get a decision that close this pump there has to be a system to close that pump.

If you make a decision that ok add this much of say this stock solution of the chemical in your rapid mix. There has to be a functionary to do that ok. So that is about this smart control system. Then smart operations automated operation and control devices valve operations and another things. And smart knowledge and information dissemination system. So which is basically data management and process information dissemination platform has to be there kind of mobile app or some that kind of system has to be in the place.

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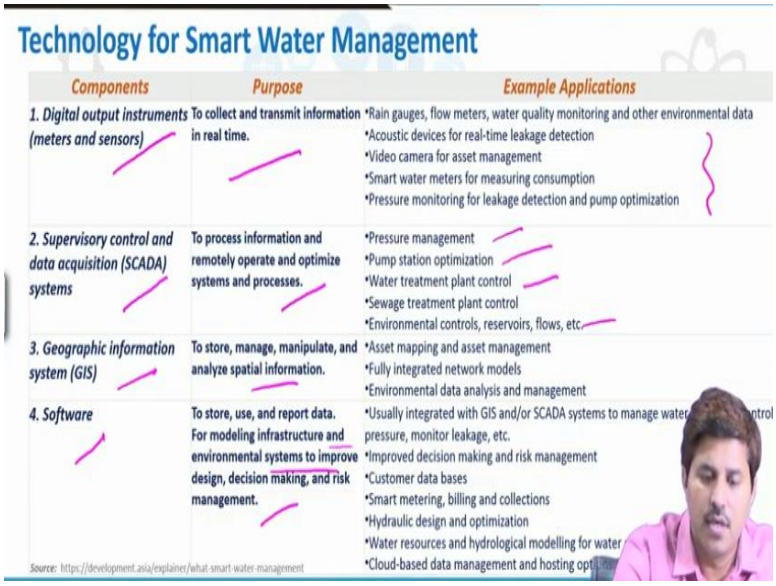

So finally like the technologies for these smart water management there are like you can see the different components. So, one component is digital output instruments which are meters and sensors ok. So this meters and sensors are for purpose of collecting and transmitting information in the real time and these are some of example applications. Then supervisory control and data acquisition like SCADA system which is process the information and remotely operate and optimize the system.

So that is one of the very important components of a smart system because whatever information like 1 way communication you can get through these sensors or a smart sensors. But the data has

to be processed and there like there has to be 2 way communication for operation purpose which is generally achieved through the SCADA or that kind of system. So it can help in say pressure management pump station of optimization treatment plant control, treatment plant SCADA is getting very popular so all these are some of the example.

Then geographic information system to store manage manipulate and analyze all this spatial information. And then there are softwares again to store, use, report process analyze the data. So for modeling infrastructure and environmental systems also and like kind of supporting design or decision making or risk management aspect we need adequate software's for that purpose.

So just we were discussing that in the previous week also like for 24 7 system or for smarter grid system, DMA based systems or software so they all can actually be combined as a component for the smarter system ok. So that is the general information about the smart water management system. So we will conclude this particular class here and next class we will discuss about the first pillar of a smart water supply systems that are the smart sensing devices. So smart meters and sensors so that we will be discussing in the next class. Thank you for joining see you in the next class.