

# PUBLIC UTILITIES MODELLING THROUGH 3D PROGRAM IN APARTMENT HOUSES

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## KEYWORDS

Public utilities, water meters, heating system and 3D modelling.

## ABSTRACT

With the progression of IT (information technologies) more things become quickly, easily and qualitative reachable for society. If an institution who superintends an apartment house could offer specific service for people that helps people get information about specific public utilities in their apartment house at every moment and could be so simple. Public utilities could be modelled through 3D program and provided from institutions who superintend apartment houses. This paper focused on specific possibilities about which data need to be used for modelling public utilities through 3D program, how to theoretically do this and get out from that more qualitative information about given services and do it quickly.

The goal of the paper is to model public utilities in apartment houses through 3D program that institutions who superintend apartment houses can use it in daily work and that's helps for people much more easy understand got services. This paper consider what kind of advantages from it get people who lives in apartment houses and how they more quick and qualitative could get information about public utilities they using. This first attempt of modelling public utilities in 3D program will be referable to two public utilities: water system and heating system.

The research idea is to use 3D program for modelling public utilities in apartment houses. Institutions who superintend apartment houses using 3D programmes could very easy systematize and automatize some things in their work and get much clearer overall picture of things going on in each apartment house. People who lives in these apartment houses could get know how they more quick and qualitative could get information about public utilities which they using daily.

As the result of modelling in 3D public utilities of apartment houses will grow up people awareness about public services in general and especially in their

apartment house and decrease number of complaints and people dissatisfaction with public utilities which they get.

## INTRODUCTION

Roots about science of metrology can find in ancient Egypt before Christ. But so long time takes then people start to pay attention and significance to measurement sensitivity, accurately and traceability. Because depending of measurement accuracy people pays extra or less for some things they buying or using some services.

The measurement system on its terms is technical and industrial infrastructure which provide consistent and internationally recognized base of measurement standards in national level and also guaranty that measuring instruments and measurements which taken with them are appropriate to legal acts requirements about metrology and conformity assessment. Also metrology includes all theoretical and practical measurement aspects, for example actual size, uncertainty of measurement etc. And in fact everybody uses measuring instruments in daily work and life. Correctly done measurement protect people health, life, environment and consumers from inaccurate and incorrect dishonest measurement effect and promote increasing quality of produced products, offered services and reliability between parties. That's very important for people living daily life.

To measure some size mean compare it to another similar size who is taken as this size unit. Measuring some physical size get this size numerical value what is expressed in accepted values. For measure physical sizes need to be use several physical equipments or measuring instruments.

First big milestone was putted in 70ies then EU (European Union) starts to adjust Global and New approach also to metrology field and withdraw first legal act - European Council Directive 71/316/EEC of 26 July 1971 on the approximation of the laws of the Member States relating to common provisions for both measuring instruments and methods of metrological control who regulating this field.

In general New approach based on following European conformity assessment key stones: - harmonization in

legal acts field; - essential safety requirements are determined; - standards and technical requirements are voluntary; - market surveillance ensured in national level; - notified bodies perform conformity assessment.

Second milestone was putted in 2006 then was enforced measuring instruments directive which includes requirements for 11 measuring instruments - European Parliament and Council Directive 2004/22/EC of 31 March 2004 on measuring instruments.

Also this new directive and other New approach directives include following requirements in general: - product scope; - placing on the market and putting into use; - essential requirements; - free movement; - assumption of conformity; - safeguard clause; - conformity assessment; - notified bodies; - CE marking.

And third milestone was putted in 2008 then improving basic conformity assessment principles through EU legal acts - European Parliament and Council Regulation EC No 765/2008 of 9 July 2008 setting out the requirements for accreditation and market surveillance relating to the marketing of products and repealing Regulation EEC)No 339/93 and European Parliament and Council Decision 768/2008/EC of 9 July 2008 on a common framework for the marketing of products, and repealing Council Decision 93/465/EEC.

In these last documents EU institutions clearly defined requirements for water meters and heat meters and their conformity assessment system.

At the same time metrology and conformity assessment are fields with which we are at the interface daily. And on the other hand numbers of people who understand these fields and know basic are really less. They are engineers, professors or people who working in organizations which are working in field of metrology and conformity assessment questions. Also if people comes into contact with these fields they recognize that these questions are very technical, specific and difficulty understandable.

From that author found one of main problems in this field – people using these metrology services every day, for example as public utility services: water system and heating system, but they do not understand simple things about it. If can systematize and automatize water system and heating system processes in general and show visually through 3D with detailed explains, author think that people will be much more informed about public utility services what's going on in their apartment houses and decrease number of complaints and people dissatisfaction. But of course it is fairly difficult to find proper way how to explain all these things to people, teach them to understand and to use it daily. It is difficult also to author of this material, because this will be the first attempt how to merge together human and computer interaction in field of metrology for public utilities of apartment houses.

Another problem is that people do not recognize importance of metrology field according to payments they doing for their flat rent in the apartment house.

These questions are going hand to hand together. There are lot of things why arise losses. If people are informed about this question more deeply they can reduce percent of losses, because they should pay for that. For this problem author offer people knowledge's improvement in field of metrology and explaining them what can be done for an apartment house to reduce losses. At the same time need to be clear that loss newer will be zero, can just reduce them as less as possible.

Thanks of science and technology development can find more and more new ways how to manage some questions in measurement field to fully ensure on done measurement accuracy and ways how to much more easily explain some technical things to society now days. The goal of research is to model public facilities in an apartment house through 3D program that institutions who superintend apartment houses could use it in daily work.

Author select necessary data and develops 3D modelling for apartment house using public facilities: water system and heating system and explain essential basics how to systematize and improve institutions work who superintends apartment houses, how improve people knowledge's about metrology sphere, public utilities they using and how to reduce losses. System given in this paper provides a possibility how to improve every apartment house public utilities and involve much more close to metrology questions and get new knowledge's to people.

It is realized by using specific 3D modelling program. A program can be chosen depending of knowledge's in IT field and specific desires which an each 3D modelling program can offer.

## **PUBLIC UTILITIES IN APARTMENT HOUSES**

One of very important things in every place in the world is infrastructure. That is important that every people or organization can get engineer technical services and supply is according to their demand in good quality and for low costs.

Author will pay attention in this paper to two public facilities: water system and heating system.

As we know water system has of course direct relationship with potable water and sewerage. Heating system variations could be depending how this system made: on water base or on gas base etc. In this paper author will pay attention to heating system which based on water circulation system.

In every city or town can find some organization, profitable or not, governmental or not, who takes care of water supply system, sewerage system, purification plant, heating system and superintending apartment houses.

Generally one organization take care of water supply system, sewerage system and purification plant. Another takes care of heating system in majority of apartment houses. And are lot of organizations who superintending

apartment houses. That is the system how these services are managed in Valmiera.

Most important public utility for all people is the water supply system. The way water goes from boring to consumer is long. For example water mains total length is 144,4 km in Valmiera. Artesian water can get from artesian boring which is made until first layer where no limestone is. That can be about 40 until 200 meters deep in the ground. From these artesian wells water goes to water filters, then to reservoirs which are about 2000 m<sup>2</sup> large. In some cities are places where water removing from iron. Thanks of this iron removing plant consumers can get water which they can use for drinking and cooking – portable water. Quality standards for drinking water chemical ingredients are very high in EU, therefore people can drink it and do not necessary to boil it before. And just then to water consumers through water mains. For example water mains provide about 92% of water consumers in Valmiera.

According to water mains enclosed apartment houses inputs. In this input place there putted one water meter for an apartment house to get know how much water was supplied to this apartment house. Organization that supplying water takes care of water mains until this water meter. Some authors according to this question thinks that the best way is to put this water meter inside an apartment house, some of them thinks that the best way is to put water meter outside an apartment house. Author agrees with first expression and thinks that the best solution for water meter for an apartment house in general is to put it inside house. As big motivation for that can mention temperature outside in winter which in last winters in some days was about -35 C°. So if according to mentioned weather conditions put water meter outside an apartment house could possible that that will frozen and then all consumers in this house stays without water or an water meter can be influenced from this weather factor and as result measurements done by it could be not correct.

Unitary water supply is monitoring through computerized distance control system. Also this organization gives calculations according indication of this water meter to an institution who superintend this apartment house. Tariffs for water were confirmed by the Public Utilities Commission. Author wants to add that this water input place in apartment house is one of points from which starts 3D modelling in an apartment house.

Further water flows through inside pipe work system in an apartment house. People can use this portable water for drinking and cooking some food, in household objects, bathroom and also in toilet as part of sewerage system. An institution who superintend an apartment house takes care of inside water pipe work system and if it is necessary repairing it.

Generally it is decision of people who live in this apartment house how to count and how to pay for used water. Also decision to use or not water meters in each flat depends on their decision.

Some authors thinks that the best solution is to put just one water meter an all apartment house and then divide used water of proportion per flats, living people, flats space and so on. Some authors thinks that the best solution is just put water meters for cold and hot water in every flat and pay according used water, according indication of measuring instrument. Some authors thinks that the best solution is to put one water meter in input place in an apartment house, in every flat also put water meters for cold and hot waters and if found some losses then somehow this payment also ask to pay from consumers side. The last described situation is used as majority in apartment houses in Latvia.

Most of people now days using water meters to calculate how much water they exactly using, Water meters they need to place according to manufacturers technical instructions and do it's conformity assessment procedure (reverification) every 4 years. Most important thinking why people start to use water meters in 90ies was to reduce payment for water. And thinking was if summarize all flats given water meters readings the sum will be equal to input water meter of an apartment house result. But never this result is equal. There are lot of questions, answers and possibilities why they are not in accord.

**Table 1:** Water meter readings if they read them in various times

	Used water	Date and time of readings	How much water really they used in 27 <sup>th</sup> 11 a.m. (with + or – mark from shown readings)
Flat No.1	15 m <sup>3</sup>	26 <sup>th</sup> 11 p.m.	19 m <sup>3</sup> (+ 4 m <sup>3</sup> )
Flat No.2	16 m <sup>3</sup>	27 <sup>th</sup> 8.a.m.	16 m <sup>3</sup>
Flat No.3	14 m <sup>3</sup>	27 <sup>th</sup> 11.p.m.	12 m <sup>3</sup> (- 2 m <sup>3</sup> )
Sum	45 m <sup>3</sup>		47 m <sup>3</sup> (+ 2 m <sup>3</sup> )
Input meter	47 m <sup>3</sup>	27 <sup>th</sup> 11 a.m.	47 m <sup>3</sup>

One of ordinary answer is – people do not take readings at the same date and time. If somebody does it in 26<sup>th</sup> 11 p.m., another in 27<sup>th</sup> 8.a.m. and another in 27<sup>th</sup> 11.p.m. and before and after these readings they using water as usually, readings will never be equal to input water meter reading which was done at 27<sup>th</sup> 11 a.m. (see Table 1). As can see from example if all flats will do readings at the same date and time the sum of it will be the same with input water meter of an apartment house reading.

Another possibility can be that people give not correct readings of water meters. Show less or more m<sup>3</sup> in period is used. And sometime people try to steal water by using some methods. For example, put magnet on water meter or squeeze water meter etc. Of course now days European Parliament and Council directives include also requirements that it is impossible to influence water meter from electromagnetic point, but then people sometimes thinks how to do this in another way. There

can help just regular controls from institution side who superintends an apartment house and discussions with people that better will be if they will show correct readings of water meters.

Sometimes problems can be with known or hidden water leakages in an inside pipe work system of an apartment house. This possibility could be if water losses are more than 20%. Then according to Council of Ministers regulations institution who superintends an apartment house immediately according to people living in this apartment house request needs to check all water inside pipe work system and try to find these water leakages. This point really works in cases then is some fissures in inside water pipe system in an apartment house. Because in general people do not know what percent of water losses they have at their apartment house every month, this information is not shown in their receipts for payment for their flat public utilities.

Sometimes to this question answer is also very simple – water meters. And the question is - do people place them according to manufacturer's technical instructions and do its conformity assessment procedure (reverification) every 4 years. What kind of class of water meters them using. There are three classes of water meters: 1, 2 and 3. First is with higher accuracy and third is with lower accuracy. Author thinks that not so important which class of water meter people using, because in social using this expenditure is not so much that there is so important accuracy from water meter class. That is important for water meters through whom flow lot of water, for example, that can be important for input water meter which is used as one inside water meter for all apartment house. Also water meters verification is determined according to Council of Ministers regulations. So that mean that people need to do these verifications for water meters and usually they do it, also institutions who superintends apartment houses also in majority of cases look after this question. The main problem now days in Latvia is that usually water meters put as that's easy to do or do it according owners thinking about flats planning. And then putting water meter not every technical personal thinks how to do this also according to manufacturer's instructions. To avoid of this is just one possibility to work more with technical people and people live in apartment houses to explain them how important is to set up water meters according to manufacturer's instructions and that as result of wrong set up of water meter result is water losses.

At the same time author offer one possibility how to solve most of these problems with water meter losses – using new generation water meters who offer possibility to read readings computerized with distance control. Also this possibility is good for side of control, because can make check readings whatever institution who superintends an apartment house thinks that is necessary. And that also be useful for modelling public utilities in 3D program. That's good for people also, because they do not need to remember that in especial date they need

to give readings of water meters. Main problem is that then in all flats in concrete apartment house need to be used these specific water meters. Water meters are people property. And that is not so easy to motivate all of them to change their water meters to these specific water meters, and of course pay a bit more for that.

Sometimes people interested in quality of water they using, because they drinking this water, using to cook something and plainly that influence their health. If they interested in they can take sample and give it to laboratory which is accredited under standard EN ISO/IEC 17025 "General requirements for the competence of testing and calibration laboratories" and have right to test water for several requirements and ingredients.

Author thinks that in future this laboratory could take some samples every day from various places, test it and results publish officially. Then people could regularly check quality of water their using daily and could link this point also to some health questions. Expenses for these tests could be included in general costs for water, so people do not need to extra pay for this position. But the goal of this could be that people will be regularly informed about quality of water they using daily and in some cases they can decide together with doctor what extra actions they need to do if there some ingredients (for example ferrous and calcium) are short. And this information about quality of water people can see in their apartment house 3D model. We have no practice like this in Latvia, but author respond in this point to other countries (for example, Great Britain) example and good references from people in this point.

Another big question of public utilities is heating system. Of course people pay extra for warm water heating in all year period. Generally they pay for that according used heat water  $m^3$  and this cost per one  $m^3$  is defined from heating calculations (most of time is the same). But in cold weather period (autumn, winter, spring), then outside is cold and sometimes very cold people need to heat their flats so they using this public utility and pay for this also extra. And then arise lot of problems again, these problems are close with people complaints and dissatisfaction with service they get.

Mainly meet problem is that in flat is cold and people need to use extra heaters and pay extra for used electricity. That is the question of an apartment house architecture, age and technical condition. If in an apartment house is done heat insulation and all people changed their pipes (radiators), windows to new ones will be warmer that without this change. Also people who live in flats with outside walls, these walls need to be done extra heat insulation, for example, with therm wallpapers.

An institution who superintends an apartment house can check temperature of pipes (radiators) in all house, do they have the same temperature or not. If not then possibly somewhere is leak, need to find this place of leak and repair. And another thing what this institution

can provide is immediately change heat feed depending of temperature changing outside. This can be done though computerized system who all the time checking temperature outside and in some flats and in case of necessary regulating heat feeding system.

Also in this point author can pay attention to apartment house standard designs and low power efficiency. And need to remember that then doing some urgent or planned repairing need to thing also about how to improve heating system, what kind of pipelines use and why exactly these not others, and what kind of benefit people will get from this.

### PUBLIC UTILITIES 3D MODELING

3D computer graphics are graphics that use a three-dimensional representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be stored for viewing later or displayed in real-time. 3D computer graphics rely on many of the same algorithms as 2D computer vector graphics in the wire-frame model and 2D computer raster graphics in the final rendered display.

3D computer graphics are often referred to as 3D models. A 3D model is the mathematical representation of any three-dimensional object. A model is not technically a graphic until it is displayed. Due to 3D printing, 3D

models are not confined to virtual space. The model describes the process of forming the shape of an object. The two most common sources of 3D models are those originated on the computer by an artist or engineer using some kind of 3D modelling tool, and those scanned into a computer from real world objects. Models can also be produced procedurally or via physical simulation. Models may be created automatically or manually.

Today, 3D models are used in a wide variety of fields. 3D visualization with a computer help now days is a real environment, objects, things or vision image, for example, territory, building external, room interior, separate item, part or object group view etc. With visualization can better find best solutions and options for specific object and can model some situations, because 3D helps in work and life and with that is easy to show some technical and hardly explainable things.

Author thinks that 3D modelling in public utilities service could bring just benefits both - institutions who superintending an apartment houses and people who live in these houses. Institutions that superintending apartment houses can better monitor all systems in one apartment house and in case of necessary quickly find problem point and repair it. People from that get quicker information about water their using and heating system, can be shore that all things work correctly and accordance to requirements.

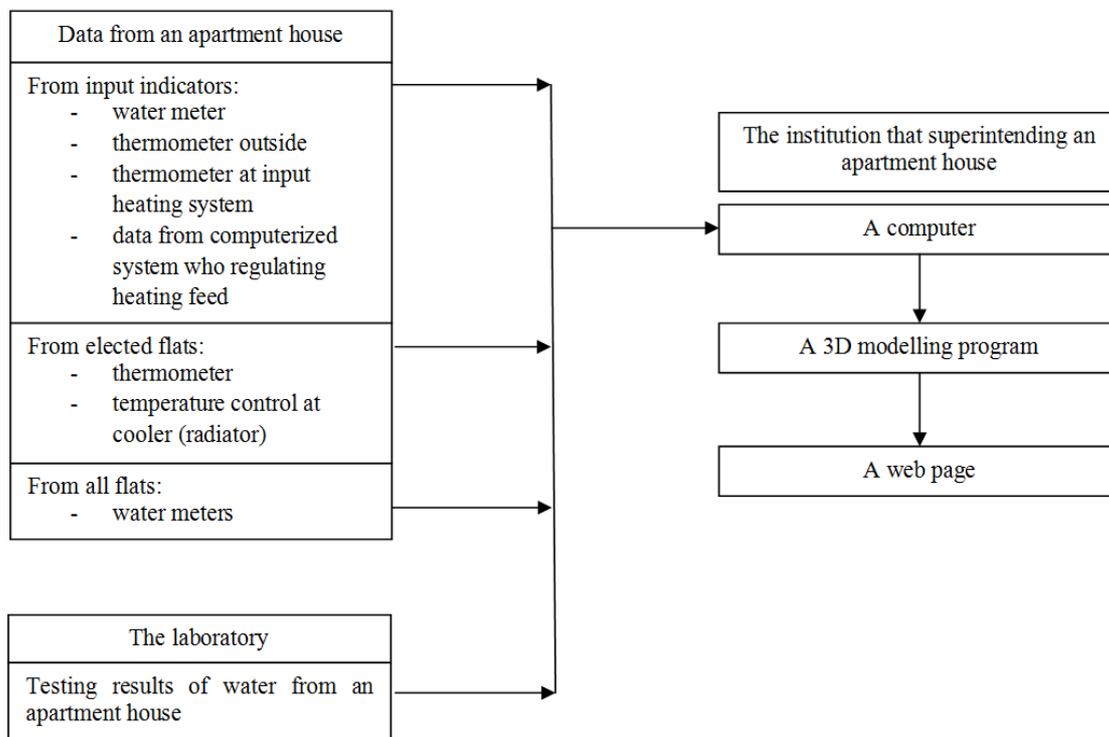


Figure 1. System of input and output data for public utilities.

Author thinks that main points in which system will be checked and from which will get information will be: input water meter, testing results of water done in a laboratory, water meters putted in all apartment house, thermometer outside an apartment house, temperature control at heating system where that inputs in an apartment house, thermometer in elected flats, temperature control at cooler (radiator) in elected flats and data from computerized system who regulating heating feed in an apartment house.

All this information goes to one computer located in the institution that superintending an apartment house, data will be processed automatically there and after that people can see all this information in these institutions webpage. System of input and output data are shown in Figure 1.

All these above mentioned data needed to be for processing them and from these new data can make changes in 3D modelling program to visually show all processes going on in an apartment house.

For providing this service institution that superintending an apartment house need server on which data can be collected; program who will proceed these data, make necessary calculations and from this goes out results which can be used in 3D program; 3D modelling program; web page connected to information going out of 3D program. All this need to be done computerized that providing related information about public utilities all the time without interruption.

## CONCLUSIONS

This paper presents how to model public utilities through 3D program and through this how can improve awareness of people and reduce problems arising and costs.

Author analysed problems related to public utilities in apartment houses. And analyse was made just for water system and heating system. Also show main problems and possibilities how to solve them. For example, one big question is about losses of water and how to reduce them. At the same time this question is very close related to people accuracy and loyalty. That is the most currency problem in all apartment houses. There is possibility how to exclude this, in all flats people need to use water meters with computerized distance control reading possibility. Thereby exclude possibility that some people are not loyal or do readings in another time.

Also author defined which data and from there need to be take for calculating all necessary going data in 3D program form modelling all this system visually and publishing it. At the same time obtainers from all this

will be people which lives in these apartment houses, because they can get quickly newest data they interested in and their awareness will arise. And also obtainers will be institutions that superintending apartment houses, because they can systematize all this public utilities services and complaints and people dissatisfaction with their offered services will decrease.

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