

<p>What services does infraPLAN offer? Are you a consulting firm or a software company?</p>	<p>We offer a solution that includes consulting services and access to a platform that streamlines many of the tasks needed to develop a successful plan of rehabilitation, as our experience has taught us that this is the best approach to help utilities at a competitive price.</p>
<p>Physical condition inspection and pipe rehabilitation are very expensive. How will you help us save money?</p>	<p>We help you achieve more with less by targeting the “best” pipes on which to spend your Physical Condition Assessment (PCA) and rehabilitation &amp; replacement dollars. We rank the pipes based on their likelihood of failure, or risk score if you choose to pursue the consequences of failure. This helps you optimize your PCA money inspecting in priority pipes that are potentially the worse based on data, as opposed to perception or random selection. The platform also allows simulating many rehabilitation scenarios and link them to the resulting break rate and business risk exposure. You can then select the scenario that is optimal. The optimal plan allows you to achieve more of your objectives with less resources by targeting the pipes whose replacement will contribute to controlling the break rate and business risk exposure. This will save you money. Furthermore, our platform, infraSOFT, compiles the knowledge we have gathered over the years. It allows us to streamline all the necessary tasks and therefore, save on consulting fees.</p>
<p>We just want to buy a software and then do everything in house.</p>	<p>You can get there and we want to help you reach that goal. However, our 15-year experience working with US utilities has taught us that it is difficult for a utility to fully implement a successful asset management program with the sole support of a software or platform. It takes more tasks than producing, for example, the risk of failure of each pipe. let’s start with data; what we will use (pipes, environmental and break data) was never collected for the sake of planning and typically needs to be adapted; cleaning or structural changes may be needed. Furthermore, we offer robust descriptive statistics that help you understand the system and put results in perspective. We therefore recommend that a first study be completed by us or by your consultant, with your close participation, using our user-friendly platform, infraSOFT. You or your consultant can then use the platform alone for updates.</p>
<p>How many years and what type of experience does infraPLAN have?</p>	<p>10 research – 15 consulting. Our experience pertains solely to the rehabilitation of water systems. That’s all what we do and we do it very well! While for our research projects we collaborated with EU labs, our consulting work has been exclusively in the US. We have been the pioneers at introducing in the country advanced methods, and are the leaders in the field. We understand where US utilities stand; their specific needs and challenges, and offer services and tools they can grow with.</p>
<p>We hear a lot about Machine Learning. Do you use Machine Learning?</p>	<p>We have been at the forefront of introducing analytical approaches to the field at the time when US utilities were just starting to gather the necessary data and nobody believed that analytical approaches were ever going to be possible in our field! We always remain on the outlook for any new approaches that will bring benefits. We have recently added Machine Learning to infraSOFT for tasks that best benefit from its formidable capacity to connect cause and effects (such as for data cleaning and forecasting). Machine Learning is one of the many tools in our box among many more.</p>

<p>What will not you do?</p>	<p>Things we will not do? Subject your data to advanced analyses it is not ready for; and not only because of GIGO; it is also possible that some pipe groups are still in the flat phase of their degradation because they have had few breaks, and predictions cannot be made yet. For those, for the time being, we will have to settle for industry estimates. Other things we will not do: generate results we cannot explain; have you distracted with (and charged for) fancy gadgets which are not your priority while important and more tedious steps are ignored; and, vice versa, settle for rudimentary solutions that are difficult to defend and which could be improved.</p>
<p>We are a small utility; we are a medium or large size utility with little or problem data. Can you help?</p>	<p>Yes. Our approach is incremental. We can start with a simple analysis with generic values. The results we generate always come with a full knowledge of the data it was produced with. For example, would not you want to know whether some predictions were generated with solely 60% of your breaks because the rest could not be assigned to pipes? Or without your oldest pipes because the material was missing? We help the utility understand what the current data quality is, the effect it has on results, and guide you through improving your data in view of adopting more advanced analyses data in the future.</p>
<p>Who will help us implement the software?</p>	<p>infraPLAN or your consultant whom we will train.</p>
<p>Why should we use infraSOFT?</p>	<p>The platform is a bottom-up tool that stems from the experience we acquired running hundreds of projects and models. All necessary tasks have been streamlined. It allows us or your consultant or yourself to produce high quality results in less time and for less money. It can complement your existing asset management software, or provide all functions if you do not have any tool yet.</p>
<p>Our consultant knows our system well. We want them to run that project using infraSOFT.</p>	<p>No problem. It is user-friendly. We will train them.</p>
<p>What data is needed?</p>	<p>Pipes (active but also, preferably, if available, abandoned) and breaks (preferably at least 5 years) assigned to the pipes they occurred on. The data can be loaded into infraSOFT as GIS shape files (which allows making use of infraSOFT's embedded map); or as csv or excel data base.</p>
<p>We already have an Asset Management software and</p>	<p>Fine. However, you may still want to use our services and infraSOFT for certain key tasks your software may not do, such as analyze the quality of your data, and eventually improve it, which will allow you to better trust the output results from your software; compute utility-specific Effective Useful Lives (EULs) generated with your utility data in case</p>

<p>prefer to use it for the planning tasks.</p>	<p>your software uses generic or rudimentary EULs. Finally, our suite of statistical charts and tables may not be available; They will help you better understand some of the results generated by your Asset Management software.</p>
<p>Can utility personnel use the platform as well?</p>	<p>Any stakeholder (planning engineer; GIS; manager; consultant, etc.) can access the platform, and each person may have a different reason to do so. For example, let's say you are a GIS technician and have assigned a junior staff the task of cleaning up some data; you can regularly supervise that work by logging on, see what was done, by whom, and when. If you are a planning engineer or consultant, you will most likely be the most active user; you will produce statistical and planning results and interpret them; if you are a senior manager, not the hands-on person cleaning up data or the engineer producing results, you may still want to consult those results at any time; which is easy as you have access to them in many forms such as summary tables, dashboard, or figures in the web-based platform, from your computer or your phone. Imagine being in a meeting and needing a certain break rate or replacement rate right away; you can connect to the platform from your phone. Those results (and many more) are there. No need to retrieve a report.</p>
<p>Why should we or our consultants use infraPLAN and infraSOFT for our planning project?</p>	<p>We have been the pioneers and are the leaders. That's all what we do and we do it very well! Our Board of Advisers includes experts in the fields of asset management, pipes physical condition assessment, and digital water with experience in research &amp; development, and consulting. Our long experience has led us to develop infraSOFT that greatly facilitates the tasks infraPLAN knows are essential for a trustworthy and robust optimized plan of rehabilitation. We have a background in research and therefore, are able to integrate the most advanced features, and deliver rigorous answers. This said, the platform is not an academic exercise; it is goal-oriented, user-friendly and very practical, designed to address what we know to be US utilities' key challenges. We have worked with many and know what their constraints are. Finally, our experience has led us to the point that we are now able to deliver the same high-quality projects in less time and more easily. No need to have an advanced degree in statistics. However, the high quality we are known for is still there.</p>
<p>Where are you based and where are your clients?</p>	<p>We are based in the US. Our clients are US or Canadian utilities. Our clients manage systems with sizes that range from 400 miles to 6,500 miles. We understand the US market and are very competitive.</p>
<p>Do you hold any certification?</p>	<p>infraPLAN's majority owner and founder is Annie Vanrenterghem Raven, PhD. infraPLAN is WBE-certified.</p>
<p>You speak a lot about data quality. We know some values are missing or may not be coherent; what else can be wrong with the data?</p>	<p>Yes, some values may be missing or be incoherent. That's rather easy to fix and we have a box full of tools to do so: statistics, spatial approaches, Machine Learning as well as a proprietary module that deals with years of installation (flags incoherent years; suggests missing ones; and guesses whether a pipe is a replacement pipe and when the original pipe was installed, all valuable information for failure forecasting that is often missing). There are also cases, where, let's face it, cleaning has to be done the hard way, by consulting source data. The tool makes this tedious task easier to manage and supervise or approve; you know who does what, when, and how. Most important (and often overlooked)</p>

	<p>are the issues pertaining to the structure of some data, that leads to continuously generating faulty values. Furthermore, some key information may be missing altogether. This said, having run hundreds of models we know that not all data has the same value; that more data is not always better. We know when to stop collecting data, and which one to invest in.</p>
<p>Do you have a library of data issues?</p>	<p>Yes, throughout our 25 years of experience we have compiled an extensive library of pipes and breaks issues. We also have a library of data structural issues that significantly affect predictions, and must ultimately be remedied. Our consulting projects allow us to constantly enrich all our libraries.</p>
<p>Will erroneous data “just” get cleaned up or will we have knowledge of what the issues are and why they exist?</p>	<p>You certainly do not want data issues to be cleaned up without knowing why it was wrong. The CLEAN module identifies issues at the pipe and break level; you know what they are and their extent, which pipes or breaks are affected; edits can be made; initial and new values show in a summary table as well as in the map. It is also important to understand the source of the issue, especially if it is not just a punctual error or oversight, but rather a structural default that will continue to produce faulty values if not fixed. So, while it may appear to be convenient, we believe that cleaning data in too automatic a manner can actually be detrimental.</p>
<p>How do we measure the quality of data? How do we keep track of cleaning progress?</p>	<p>The CLEAN module generates an indicator of data issues at the system level but also for each issue so that you understand where the issues are and their extent. Edits are tracked throughout the cleaning process (who did the edit and when). You can follow the progress as you invest in cleaning.</p>
<p>What kind of statistical entities can be computed? How are they computed? Are they configurable? Can we download Figures? Tables? What are the statistical results used for?</p>	<p>infraSOFT, in its STATS module, has a built-in set of statistical entities that have been carefully designed over the years. We know what matters and how it can be used to understand your system and interpret the forecasting and planning results; we do not just give you answers; we explain why; for example, which pipes are most likely to break or have the highest risk score, and why. That suite of essential statistics is produced automatically upon loading the data. Furthermore, infraSOFT is dynamic. Therefore, statistical results get automatically updated as data is edited in CLEAN. In addition to the built-in core statistics, the user can generate many variations with different populations of interest or variables using the cloning feature. Downloadable Figures and Tables can be produced. The main results are compiled in a configurable dashboard.</p>
<p>What’s in the dashboard?</p>	<p>You can show in one single table, at the (configurable) cohort level, the main statistical entities (descriptive and forecasting) such as length, break rate (past, future, over certain period of time), average yearly break rate, age, rate of replacement, speed of aging, EUL.</p>

<p>Give us an example of statistics that help interpret results that are rarely generated and utilities have found to be very useful.</p>	<p>There is often a gap between planning and field operations. We produce a whole series of results that help you better understand your past program of rehabilitation, determine whether the utility is replacing the worse pipes, and the effect replacement has had on controlling the break rate. We generate the kind of statistics that, for example, help you track the break rate over time but also understand whether the trend is thanks to the past investment the utility has made in replacement or if the system is just not aging yet.</p>
<p>Another example?</p>	<p>Many utilities want to produce past and future aging curve (break rate by age); it is often wrongly drawn as the break rate at the age as of now (current year minus the year of installation), which is not accurate.</p>
<p>Word of wisdom about statistics</p>	<p>Avoid quick rule of thumb back of the envelop computations like number of breaks/length/number of years of breaks. In most cases it is not that simple and will lead you to a wrong answer, sometimes substantially wrong for younger pipes or pipes that have already experienced a lot of replacement.</p>
<p>Can statistics be used for other purposes?</p>	<p><b>Absolutely. Results can be consulted at any time. They are on line and readily accessible. No need to open a report.</b></p>
<p>When it comes to failure forecasting, what exactly are the deliverables?</p>	<p>Likelihood of Failure (ranking and probability of failure); Predicted Breaks Number per year in the future and per pipe; aging curve (break rate by future age); risk-based Effective Useful Lives and Remaining Useful Lives; speed of aging; increased likelihood of failure of one value versus another one (for example MAT1 3.5 times more likely to break than MAT2). All those deliverables are produced in the PREDICT module of infraSOFT.</p>
<p>Do you provide pipes ranking to help prioritize pipes inspection or rehabilitation, for example?</p>	<p>Yes, of course, and much more.</p>
<p>What should we do with our planning budget, inspect pipes or run a statistical analysis?</p>	<p>Those are not competitive approaches. If you need to know in what condition a specific pipe is, inspection is the way to go as statistics give trends, or to the best, rank pipe (which does not mean that the worse-ranked pipes are in a condition that necessitates that it be replaced). However, the cost of physical condition assessment is proportional to the length inspected. It will take a while (at a substantial cost) before you have inspected a statistically significant portion of your system that allows you to draw conclusions about the physical condition of the whole system. On another end, running a statistical analysis on a large system is not proportionally more expensive than on a smaller one (actually the more data the better). Therefore, statistics and physical condition assessment are truly complementary. A lot of our clients do both in a synergetic way with each approach enriching the other. Our next module will solidify and systematize the combined approach we are currently developing. Our recommendation would be to start with a</p>

	<p>statistical analysis to improve data and optimize the investment in physical inspection. And vice versa, when enough inspection has been completed, use those results to validate and consolidate the statistical predictions.</p>
<p>What types of models do you use for forecasting of Likelihood of Failure and ranking pipes.</p>	<p>Advanced multi-variable regression model (takes all variables, breaks and times into account simultaneously) + Machine Learning (Machine Learning)</p>
<p>Which variables are taken into account in the failure forecasting model?</p>	<p>We look at the physical characteristics of the pipes (material, diameter, Year Install, Year abandon, length, pressure, breaks and age at breaks) as well environmental factors (zoning, traffic, soil, groundwater, landfill, proximity to infrastructure, etc.). We also need breaks assigned to their pipe and the date of the breaks. We use the data that is readily available, and look at the cost/benefit of collecting additional data. Quality matters more than quantity. We know by experience that modeling benefits more from some key good quality data than from collecting many variables that only bring marginal improvement. For example, ensuring that breaks are assigned to the right pipes is critical; that investment goes a long way.</p>
<p>What is your basis for Machine Learning? Why is it strong?</p>	<p>We have 25 years of experience modeling water pipes network; we understand the specificity of pipe and break data sets; the challenges and constraints; we have access, from our previous projects, to 1,000,000 data points to train Machine Learning models; we also have access to hundreds of forecasting statistical models which we have used to validate output results from our Machine Learning model.</p>
<p>You have modeled water pipes systems for a long time using advanced statistical regression models? What is the advantage of using Machine Learning? and the drawback?</p>	<p>Calibration is not automatic with an advanced statistical regression. We use the statistics generated in the STATS module to help us decide how to regroup pipes and organize the variables in view of that type of modelling. While this may appear tedious compared to Machine Learning for which calibration is more automatic, those steps have provided us with a deep knowledge of the data specificity and helped us define the best underlying model for Machine Learning. Furthermore, those statistics give us a good understanding of the system (for example why, despite having the same recorded material, older pipes may be in better condition; is it the same material or are we left with the best pipes after the worse ones have been replaced?), value that would be lost if we only used Machine Learning which does not, per se, require those valuable pre-modelling computations. The advantage of infraSOFT is that, while statistics are no longer needed for a Machine Learning approach, they are still there to help you understand the data, system and interpret results. So, we are not completely letting go of the old ways.</p>
<p>What about Consequence of Failure (COF)? Do you take this into account?</p>	<p>Absolutely. If the utility chooses a risk-based approach, we can help them compute the COFs. They are 2-fold: too much water/flooding; not enough water/service interruption, and require access to the hydraulic model for hydraulic criticality (which can also be assessed in a more rudimentary way with the GIS if a full hydraulic modelling is not available), and to the GIS to identify targets and customers. We have a very robust library of risk-based criteria for</p>

	<p>project prioritization (robust because we have the experience needed to avoid redundancy, counting a factor twice, a frequent problem with COF criteria). They can even be monetized if data is available and it is a preference of the utility, or scored. The COF analysis is not something that can be automated as it requires substantial input from the utility. Therefore, it is typically a separate project done outside of the platform until each pipe is given a COF score which are then loaded into the platform. Our approach requires at least one workshop with all stakeholders.</p>
<p>We also replace pipes for reasons other than physical condition and risk of failure. Do you take this into account?</p>	<p>Absolutely. We are familiar with the fact that a pipe can eventually be replaced even if in great physical condition, for reasons having nothing to do with physical degradation. Those criteria are added to the risk-based criteria (defined previously) to generate a priority score. This is part of the pipes' prioritization project outside of the platform. The prioritization scores are loaded into the platform.</p>
<p>How do we rank and prioritize pipes in view of upcoming inspection or rehabilitation?</p>	<p>To prioritize pipes, you can use the Likelihood of Failure (LOF), the Consequence of Failure (COF) or the risk score (LOF x COF). Let's face it, not all pipes cohorts have enough breaks to generate a trustworthy LOF. However, their COF may be very high. Those pipes may need to be inspected even if the LOF is low. A comprehensive approach is recommended.</p>
<p>Once we have prioritized the pipes, how do we generate a long-term plan and see how that plan affects the performance of the system?</p>	<p>The PLAN module makes use of all the previous results, and allows the user to quickly simulate many Rehabilitation &amp; Replacement scenarios that integrate pipes candidates for replacement for many different reasons, until a preferred scenario is produced. The user can set a length of Rehabilitation &amp; Replacement for every year of the planning horizon. The module picks, for each year, the priority pipes (based on LOF or Risk score) and computes the resulting break rate, Business Risk Exposure (LOF X COF), Rehabilitation &amp; Replacement cost, and rate of replacement. Tables and Figures can be downloaded.</p>
<p>We want to convince our city council that more investments (inspection or Rehabilitation &amp; Replacement) are needed than what's in the current CIP. How do we do that?</p>	<p>You can reproduce the existing CIP in the PLAN module. Then you need to decide whether you want to prioritize the pipes ranked by LOF or Risk score. If the resulting break rate and Business Risk Exposure continue to climb at unacceptable levels within the planning horizon, this will be illustrated in easy-to-read Figures that should help the decision-makers assess whether more money needs to be allocated, at least for inspection, and eventually for Rehabilitation &amp; Replacement.</p> <p>You will more easily win your rate cases, and convince your boards, city councils and customers that some investments are necessary, because the work done with infraPLAN and infraSOFT leads to an optimized plan obtained with trustworthy data and for which each step can be clearly explained.</p>
<p>Can you provide a report?</p>	<p>We do. The report is stamped by a firm with an exceptional track record. We can also help you put a convincing presentation together. The Tables and Figures created in infraSOFT can be included.</p>



<p>How often should we run a study?</p>	<p>As often as you want. We recommend that infraPLAN provide you or your consultant support for the first study. Then you or your consultant can run those studies yourself. You are likely to see more changes in the results when there have been a lot of breaks or replacement, which is something you can track in the STATS module. We recommend a new study at least every 2-5 years depending on the age and break rate as well as aging speed of your system.</p>
<p>Are new modules in development?</p>	<p>Continuously; our platform is constantly enriched by our consulting projects, and the demands and needs of our clients. For example, we already know how analytics can help prioritize physical condition assessment by ranking pipes based on their Likelihood of Failure. There is more that can be done when it comes to combining inspection data with statistical results. Several clients have asked us to look at how one set of results can validate the other; and how both sets of results, when combined, can help finetune the Remaining Useful Lives of the pipes, and the Rehabilitation &amp; Replacement plan. We plan to systematize the approach we have developed into a new module.</p>