T101 - Reliability of predictions based on computer models, for example, weather and global warming by Roger Maue

There are a lot of issues that concern the reliability of predictions based on computer models, such as the weather predictions where there are fields of expertise all specializing on it. This paper will focus on weather about its effect and importance. The importance of the weather and the need to predict it accurately is illustrated by the fact that every local news show includes weather forecasts. People need to know what the weather will be like–either where they are or where they are going–so that they can plan their activities accordingly. One of the problems with weather forecasting is that weather changes quickly in time and space. A weather forecast at 8:00 in the morning may not be reliable at 3:00 that same afternoon. A weather forecast in one city is not the same for neighboring regions. For this reason, local weather people never say what will happen, only what is likely to happen in the local area.

It was during the 1980's and 1990's, the accuracy of short-range (1-3 days) and medium-range (4-7 days) weather forecasts improved significantly. Weather predictions issued for periods longer than seven days are known as long-range outlooks. Advances in computer power and technology have now make it possible for the National Weather Service to produce meteorological forecast charts of possible future weather conditions out to 16 days. For example, the Global Forecast System (GFS) is a computer model that currently predicts general weather patterns and conditions out to 16 days. According to R. Clayton Brough, ABC4 (KTVX) Climatologist, "When such [long-range] computer models are used in conjunction with known climatological patterns and probabilities they can generate accuracy levels of 55% to 65% relative to general weather patterns--such as drier or wetter or cooler or warmer than normal conditions--over an expected area and period of time."

The weather is really unpredictable a hundred percent so a lot of weather reporters are careful in their use of language during broadcasting the weather. They try to present it so that it sounds that it will be as they predict it will most likely turn out to be but also that they will not be taken responsible for incorrectly predicting the weather. Also the presenting of the weather on screen as seen on computer models must make sense to viewers as the weather presenter talks of it for it also provides a kind of psychological approval to have a visual aid of some sort. Wrong predictions (which is becoming lesser these days) can be attacked for it can affect a lot of daily life and activities so weather but good prediction means a lot to people who use it to their advantage to plan or do things now that they have a sort of guarantee of a good weather.

The weather has such widespread impact on people's personal lives, including their jobs, their recreation, their safety, and their property. When the weather is bad, many activities become more difficult to perform. Commercial transportation slows down on the roads, on the waterways, and in the air. Businesses of all kinds are interrupted by bad weather. Power plants and energy traders rely on knowledge of the weather to operate their equipment and to deliver power to consumers, government and business. Knowledge of the weather and associated winds allows commercial and general aviation to operate safely through hazardous weather avoidance, and to operate more efficiently through fuel savings. When all of these factors are taken together, it is easy to see that extreme cases of bad weather are responsible for the loss of tens of billions of dollars each year.

Weather also affects everyone in a sort of way as seen in the huge hurricane Katrina where trade was affected as New Orleans had one of the sites that tourists visited so a lot was lost in lives both American and foreigners and economically the city was devastated and cost the govt. about $81.2 billion.

It is the public's right to know the right weather so they should be provided by the correct information by the weather people so that they can for it is them who subscribe to the News Channel and they are responsible for providing the weather predictions for the public and misinterpretations shouldn't exist or must be taken into account cause it might mean lives if weather people or the meteorologists that read the data and interpret for the presenters for it could provide warnings and save peoples lives, properties, etc. Bad presentation/prediction can be taken against the weather people who don't correctly present the weather or natural disasters and a lot of lives are gone.

In an effort to protect lives and property, there is a wide-range network of radars that help forecasters accurately predict severe storms and hourly weather trends.
Ex: Another new system that is used by National Weather Service Forecast offices is the AWIPS computer system. AWIPS (or Advanced Weather Interactive Processing System) forecasts the process by combining a number of separate data sets and communication systems into one. Using the latest technology, this system allows meteorologists to manipulate these data sets in a myriad of combinations for use in the analysis of the weather, resulting in more timely and accurate warnings and forecasts. But it is new and costs a lot of money which some countries or organizations can't afford and may still use the old system plus there isn't much adaptability to it yet so a lot is still to be learned and its potential abilities.

T102 - Economic effects of the use of models to design and test new products by Haider Ali Shah

The use of models in any situation only arises when it is more efficient to research and test theories and products on models before applying them to practical situations than it is to jump right into the real world. Let's take a very straightforward example: dummies in vehicle crash tests. As we've all seen in videos and perhaps in real life, dummies in crash tests are made to model physical human behavior in a car crash, which can be observed with sensors and cameras. The use of dummies hence removes the need for people to experience the car crash to help test the car's safety features and provides useful data to researchers, which they can use to improve the car's safety.

Just like the crash test dummy, most design models exist so it's easy for researchers to test products and theories. Models have existed before the advent of the computer in many forms, such as setups for physics, economic models, and chemical solutions. However, since computers have become available, models are increasingly being created using computer simulations. Not only electronic goods (such as mp3 players) are designed and tested on computers. Models for almost anything, such as cars, can be created and tested using computer simulation.

The resulting economic implications are simple: models remove the need for ideas to be tested in the real world and hence provide as low-cost, low-risk research objects, enhancing the production and practicability of products.

However, models are only effective when they simulate reality accurately. Even though the use of models to design and test new products has positive social effects, when models inaccurately represent reality, negative social implications may arise. Like in the case of the crash test dummy, if the dummy fails to accurately model the physical behavior of a human being in a car crash, the results of the test may be different, and may affect the actual safety provided by the car when it is released.

Like I've said in previous papers, even though technologies that help improve human life often come with drawbacks, they are employed because the advantages they provide outweigh the disadvantages. Similarly, the positive economic effects derived from efficient designing and testing due to models are considered to outweigh the innate risk of inaccurate simulation and the negative social effects resulting from it.

T103 - Security issues involved in military simulations by Su Chen

Military Simulations also known informally as Wargames that are simulations in which theories of warfare can be tested and refined without the need for actual hostilities. Many professional analysts object to the term wargames as this is generally taken to be referring to the civilian hobby, thus the preference for the term simulation.

Simulations contain varies forms, with varying degrees of realism. Especially in recent times, the range of simulation has further expand to include not only military but also political and social factors, which are close related to each other. While many governments make use of simulation, individually and collaboratively, little by little it becomes a tool which governments test and refine their military and political policies. Military simulations are seen as a useful way to develop tactical, strategically and doctrinal solutions.

Despite from the meaning of Military Simulation, it can be used to cover a wide spectrum of activities, ranging from full scale field exercises to abstract computerized models (satellite) that can proceed with little or no human involvement. The essential purpose of Military Simulation is to protect the country from the terrorists' attacking. But how it is going to protect people from the dangerous?

As I mentioned above, military simulations do not need the real hostilities. When the terrorist really happened then it is too late for any actions. Therefore the main purpose of the military simulations is to prevent the terrorists' attacking happen, supervise anything that may threaten the social security. To do so, Military Simulation needs to collect most reliable data to provide enough information for making the decision.

Before, it is very hard for them to collect the information completely, since technology at that time are not that advance. The collection of information becomes the biggest problem for the Military Simulation. Without enough information, Military analyzers can not make the right decision thus will delay the chance to defeat some possible terrorists' attacking.

Overall, the society will be threatened. Luckily, to solve this huge problem, scientists develop the satellite which can be the third eyes of the Military Simulation. Unlike the civil satellite, military satellites are much powerful. They not only can transfer the data in a super fast speed, but what matters more is that they can reconnoiter some areas, lock the target for alliance' weapons, and can track the moving target as well. The invention of satellites helps to reduce the difficulty for the anti-terrorism.

Full-scale military exercises, or even smaller scale ones, are not always feasible or even desirable. In other words, sometimes, military analyzers will also make the mistake. The cost is possibly the highest among all other

military activates. Since, if Military Simulation predicts that will be a attacking or bombing. Then they will have to mobilize all the local police and sometimes even soldiers to defeat the terrorist.

And it also requires to scatter the innocent civilians, and possibly to transfer them with some expensive or valuable material to other suitable places, and then need to cover additional expenses such as Petroleum Oil Lubricants usage, equipment maintenance, daily supplies and consumables replenishment and other items. Furthermore, it may create the social panic. Therefore, military simulation can provide the social security, but in the same time, it may possibly destroy it.

The social issue of the military simulation is that in some extend, it really help to achieve the social security issues. Since recently, the problem of terrorism tends become more and more serious. Lots of innocent people lose their lives, especially for the event on 911. It is not directed against America but the whole world. Countries have to take it seriously. And it is necessary to have the military simulation since no one wants this tragedy happen again. I believe that through the military simulation, social security will get ensured.

T104 - Social impact of reliance on simulations to examine issues of public policy by Haider

As I discussed in my previous paper, it is easy to create models to simulate reality when it comes to designing and testing new products, and the economic effects that result are generally positive. Public policy, however, unlike goods, has a much deeper social impact, and the effects from public policy on people are significantly harder to simulate using technology.

When designing a product, a designer can simulate its behavior using a computer model and understand how the product will act in the real world. The most fundamental issue with relying on simulations to examine the effects of public policy is that it is almost impossible to simulate human behavior in any situation.

That, however, does not mean that simulations that model human behavior don't work. The effectiveness of a simulation comes down to how sure the person creating the simulation is of the behavior of the object he is modeling. A product designer can break down his object's behavior into numbers and create simulations from there. With such objectivity involved, simulations tend to be very accurate, as 1 plus 1 almost always equals 2. Simulating human behavior, however, becomes more difficult due to the subjectivity involved.

The accuracy of simulation hence comes down to objectivity and subjectivity. Keeping this in mind, two hypothetical issues of public policy can be examined:

1. A decrease in interest rates. A decrease in interest rates means that saving money and depositing it in banks is no longer as attractive to people as it was before. Also, with low interest rates, businesses can afford to borrow and invest more. Hence, investment in the economy increases, leading to economic growth. This has been modeled by various economists over the years, such as Harrod and Domar. Although no such model ever comes to being 100% accurate at simulating the behavior of the economy, the mathematical objectivity involved allows models simulating the economy to be fairly accurate.

2. Devoting more of the annual budget towards poverty alleviation. No one knows how people will react to this policy. Hence, the subjectivity involved here hinders the formulation of a simulation to examine the issue in detail.

The social implications that arise from this are vast. Like simulations helping with product design, simulations that help analyze the effects of public policy make it easier for policymakers to understand the effects of their policies. However, as discussed, the subjectivity that's involved with simulating public policy makes it almost impossible to create simulations that are 100% accurate. With inaccurate simulations, policymakers may create policies that may harm social welfare, creating a negative impact of reliance on simulation to examine

T105 - Responsibility of the designer for accuracy of assumptions underlying the model by Sujit

Some of the issues concerning the responsibility of the designer's accuracy is that if he doesn't build a model that is exact, when you try to make something it is going to be like a misfit. For example if you build a model of a bridge you are going to make if you don't have the exact scale close to a millimeter then one section of thebridge will not fit with another and they cant continue to build the bridge with what they have.

The people who gain from this are the people who build whatever it is they are building and the model builder. What they basically get is money and fame. Fame is not for everyone but people who build bridges and other tall skyscrapers will be well known.

Some of the advantages of model building accuracy is that you will understand exactly what needs to be done when building the real thing. If you don't have this model accuracy then you can't build whatever it is you want to build because if you try to make it will just collapse because sections don't fit together or by chance something went wrong in the beginning and things went in smoothly after that. There is no disadvantage of designer's

accuracy but for the builders it takes time and money. If the builders fail to build the structure they will be losing money instead of gaining.

One of the solutions to more accuracy is probably to make the blueprint of the structure more accurate. If they do this they can build a model with more accuracy than when you have a blueprint that is not accurate. And also you should probably use magnifying glass or something like it to make it more accurate. With a magnifying glass you can see more accurately what can be done right and what is most likely to go wrong.

Building bridges, towers, etc. will have an impact on the city itself. First of all something new is going to be added to the city, so it will change how the city looks. It also has an impact on the people who are living their. People are expecting to use these things so that we can do things and get to places more efficiently. If they hear that you cant build something it affects them badly because they were waiting for the builders to finish building the structure, so that they can use it.

The people who are held responsible for this problem is the designers themselves. Because they were not accurate in what they were doing the structure could not be completed. If they had been more careful in doing things properly the builders would have finished building the structure and it will be ready to use for the people.

The people who are held accountable for this situation is the builders. They are the one who are going to build this structure. So they have to check first if everything is in the proper order. If they don't something will go wrong and they cant build the structure. And also the builders are responsible for if they don't use the right materials. It is dangerous because the material might be too weak to build with.
The alternative decision is to not rush everything. The builders should take their time and analyze the model. This way they can pick out all the mistakes that can be fixed from the model and fix it. Though this way will take a lot of time the project will be error free.

T106 - Ethical considerations involved in deciding when to use models or simulations to ensure human safety by Chaan

In science today, models and simulations are used a lot in order to explain complicated things. The simplest model I can think of is the periodic table used in chemistry. However, even models become complicated once you become a doctor or a physicist. As a doctor, there are many ethical issues that one must think of.

One of the ethical issues is whether to use computer simulations in case of humans. For example, in Duke University an adult mannequin is used as a simulation which is programmed to respond appropriately to the environment and basically it can act like a human being. These mannequins are computer controlled and one of the reasons this is being done is so that doctors can understand human beings better. However, this is where the ethical issue comes in. Can you really and sincerely trust this technology with a human being's life? Let's say a very sick patient comes to the hospital and it just so happens that the doctor had programmed the mannequin to have the same sickness this human being has. So the doctor just gives the new patient medicines that he gave the mannequin since the medicines worked on him. Is this really ethical? How can a doctor play with a patient's life like that?

That scenario is based in a hospital. A lot of people are using computer models today and basing their products on these models. For example, engineers use simulations when testing new cars and then they sell it to the consumers because they are sure that the car is perfect since it worked perfectly on a computer. Is that really ethical? A car vendor just wants to make money so he uses a simulation (just for the sake of it) and makes sure that he can prove to the court (in case somebody sues) that he checked the car's safety on a computer. I don't think it is the right thing to give a person's life into a computer's hands.

In order to ensure safety, real human beings must be tested instead of a computer simulation. One might argue that real human beings might be affected. Well how about we try someone who's about to die or has already died? That has more credibility to it than testing the model on a computer!

Knowledge of technology
In order to study and evaluate the social and ethical issues involved in the use of modelling and simulations, the student must have an understanding of related technological concepts. These may include:

T107 - Key terms —model, simulation, feedback loop by Xiao Xiao Li

Model – A model is basically a representation of something big. Maps are example of models. Dictionary defines a model as "a simplified description, esp. a mathematical one, of a system or process, to assist calculations and predictions." In this case, they are defining models in mathematics but that's not the only place where models are used. Models are used everywhere today. In real life – the biggest example is a map and small subway maps and statutes etc. In subjects, economics – the circular flow diagram and in biology diagrams of the human body! All over the place!

Simulation – Dictionary defines it as "producing a computer model of something" and that's pretty much what it is. A simulation is basically a simplication of reality. Simulation is used in many contexts, including the modeling of natural systems or human systems in order to gain insight into their functioning. Other contexts include simulation of technology for performance optimization, safety engineering, testing, training and education. Simulation can be used to show the eventual real effects of alternative conditions and courses of action. Simulation is often used in education. For example, the other day Mr. Sirkka used computer 3-D modeling in order to explain how two chemicals bond to each other and what angles they form! Simulation is often used in war scenarios too. For example, scientists test how a bomb will affect the city and the people living in it through computers and simulation!

Feedback loop – This is pretty hard to explain but I'll try my best. According to the dictionary, "A feedback loop is a system where outputs are fed back into the system as inputs." Basically, feedback loop doesn't really mean anything by itself. It is usually used in order to explain other things. For example, it is used to explain the cycle of poverty. Cycle of poverty means that the poor will always remain poor and this is explained by the "negative feedback loop". Basically this means that since the poor people don't have the resources to save and invest, they'll never get a start on the economic development process. This is the feedback loop – you can't put in the resources and thus won't get any output so that's why there's a "negative feedback loop." A positive feedback loop would be where people are earning a lot of money and saving that money in their banks and thus "outputs are feedback into the system as inputs!"

T108 - Faulty or hidden assumptions by Romeo Wu

An error is very hard to correct if we don't suspect there was a mistake. Often we make an incorrect assumption without realizing we made it, and then draw other false conclusions based on this false assumption. One area where this happens frequently is in finding errors in computer programs.

An assumption that we probably all make sometimes is that what we read in the newspaper or see on television news is true. Sometimes newspaper or television will mass reproduce the news that is untrue which is known as the propaganda. For example in my country, the political is divided into two parties Nationalist Party and Democratic Party.

Since the nationalist party trying to suppress the other parties they would use the newspapers, televisions to produce fake information. Some people would make believe the information and make false assumptions since most of the media is presenting the information although the information is not true. It probably never occurred to most people at the time that this fact was in doubt. Unfortunately this was an assumption that had practical repercussions for most of us. Magicians deliberately make use of people's assumptions to make their tricks impressive. One of the most impressive trick I could ever remember is when a magician asks to see someone's watch, holds it up by the strap, and announces "it now says the correct time, 8:10 PM", and then hands it back to the owner. After doing some deep mental concentration, he announces that he has made the hands move forward. He asks the owner to read the time, which now says 9:30 PM.

What happened? Actually the magician spun the hands forward before holding it up and announcing the time. Almost everyone in the audience assumes that the time read out loud by the magician was correct, and so they are mystified because there was no opportunity for the magician to influence the watch after the announcement. It is nearly impossible to avoid making assumptions which may occasionally be wrong. Our brain has to constantly make assumptions if we are going to respond to what is going on around us in a timely manner, and, of course, most of the assumptions are right. We should be aware, however, that we will occasionally be fooled, and we should be careful for those occasions.

T109 - Extent and effect of the simplification of reality by Xiao Xiao

Simplification of reality is intended to promote understanding of something complicated. It doesn't always have to be complicated, but most of the times it is. Hence, it has to be "simplified." Without simplifying reality or "creating models", some things would be impossible to understand.

The extent of this issue is quite huge actually. Models are seen everywhere in today's world. Life is actually quite unimaginable without models. Perhaps, one of the biggest models used and seen in today's world is a MAP. We see maps all over Tokyo. Maps of subways, maps of JR train lines, maps of a particular area etc. Maps are all over the place and I for one couldn't live without one. Google Earth has greatly advanced the way we use maps and by using a model or by "simplifying Earth" they have allowed people to look at their homes through satellite view! Extent of map usage is really huge, especially for foreign tourists. I remember when I went to visit London, people were walking around with maps all over the place and they would have been really lost if there hadn't been maps to "simplify reality."

We use models everyday in school and they are mainly used to learn. Just like the extent of it, their effect is great too especially for students. For example, understand economics would have been really hard without the PPF (Production Possibility Frontier) model and the circular flow diagram. Both of these models "simplify reality" and explain how an economy takes it's decisions and how money flows in an economy, respectively. Models are used

in other subjects too for instance periodic table in chemistry and geometry! And of course, we can't forget the maps in geography.

Therefore, simplification of reality is a must since understanding certain things at full scale would be impossible. There is one problem though that details are left out when simplifying reality. However, the advantages greatly outweigh the disadvantages and hence extent of simplification of reality is huge in today's world.

T111 - Processing power needed to create complex models by Raymon

Models are physical or graphical simulations and representations or what will happen in a certain situation for things that cannot be seen or observed by the naked eye easily, or cannot be really observed in real life at all. They also show scientists what will happen in a certain situation in theory, and are used to understand the deeper roots of physics and quantum mumbo-jumbo that layman will never understand in his lifetime.

In school, models are often little plastic or paper-and –ink pieces of work that show students how an atom is supposed to look, how the solar system is laid out, or show them what DNA looks like. In the laboratory, however, the hardcore research that must be represented in models is simply far too complex to show in a static, plastic model, or requires movement to show what is going on. This is where the powerful computers called supercomputers come in. In older times, supercomputers were about as powerful are our TI calculators we use today and did about the same stuff. They could do some simple simulation showing the speed of a molecule or what will happen when a ball bounces around a room. These simple models can be seen in games today, with the physics engines employed to make a grenade bounce around a room and blow somebody's leg off in an entirely convincing way. So, if this then-complex simulation can be seen in everyday life today, what do the calculations done by supercomputers look like today?

Blue Gene/L is currently the fastest supercomputer in the world. The fastest speed it has reached is 207.3 Teraflops – 207,300,000,000,000 floating point calculations per second; a floating-point calculation is something like π × 5.38194381. As you can see, the rate at which these machines can process information is mind-boggling. Blue Gene/L has a total of 131,084 processors so do this immense work. This immense power has allowed mathematicians and scientists to do calculations previously thought impossible, unable to be understood by the human mind, and completely useless to ordinary people; just recently, researchers completed modeling E8, an immense mathematical equation that, if put on paper, would apparently cover the city of Manhattan.
Perhaps, the power of these modern machines would be enough to solve any questions humans have. But if you thought that, you would be wrong, as a science magazine (Spectrum) was recently lamenting the inability to simulate the convergence of a galaxy and see how galaxies come together in such a fashion and spin in a certain direction. To even model a nebula coming together to form a new star, one would need so much processing power that one can wonder if it can really ever be done. A nebula is basically just a huge cloud of hydrogen – one that can contain, in theory, 1027 molecules of hydrogen. Each molecule of hydrogen has a gravitational pull to all 1027 - 1 other molecules in the nebula. Therefore, the machine would have to do 1054 calculations, something that would take even blue gene 5.583 × 1034 days.

T112 - Visualization of information by Sam

What is Visualization of Information?
The world we live in contains so much information that we just simply can't keep up with everything. Information is represented in various ways. We can hear something from our friends, we can read the news, search the internet, etc… To us humans, it is normal that there is various ways to represent the information. In computers, the same thing can be said. Information that goes in as inputs to the computer can have many forms it can take as an output. First of all, we have to understand that most of the modern computers are using graphical interface, therefore visualizing information even at the operating system level. So since from the operating system we are seeing visualized form of information, it is not surprising that most of the data in modern home computers are visualized in some way.

Advantages of Visualization of Information
Probably the biggest advantage of visualization of information is the fact that it makes everything simple. Do you remember the days of DOS? When operating systems did not have graphical interface, it was often too difficult for the average Joe to use it. Without graphical interface, many people would not be able to enjoy the use of computers as it would just be too difficult. Another example is graphs and tables generated in computers using different software. By just displaying data, it isn't organized and probably hard to read. By making it in the form of graph or table, it allows viewers to easily understand the data.

Another advantage of visualization of information that it allows unified form to be used across the globe. Just the raw data will not always be understood anywhere, but by visualizing it, most of the people across the world can see what it is.

Disadvantages of Visualization of Information
When you visualize data on your computer, you are creating a visual representation of the data presented. Even though most of the time these representations are precise and exact, that is not always the case. When representations are made, for example graphs, sometimes there are small glitches between the data and the

graph due to technical difficulties on the part of the software. Sometimes the data are too precise for the software to perfectly represent.

Another disadvantage of visualizing information is that let's say in case of an operating system, many advanced computer users would rather prefer to use the commands and get to their work quickly rather than waste time on an operating system with graphical interface. With visualization of information, sometimes things get more complicated than they need to be.

Therefore sometimes using visualization of information can be inefficient.

T113 - Correspondence of the model with reality. by Tomer

Predictions and models are tools used to describe the world around us and the world that could be around us, but most importantly, they are used to predict what is going to happen based on current knowledge. Models have place in almost every field including, mathematics, physics, chemistry, meteorology, astrology, economy, and geology. However, sometime models are wrong, which may have some negative consequences.

1. What are the issues involved in ITGS?
2. How did this technology emerge?

Information in the IT world is always presented in models, mostly mathematically based. Whether it is a 3D graph, animation, or just a calculation, to generate a model a certain computation power is required. The stronger the computer used to generate the model, the better the model can be generated. Mass computations are required to predict air currents, while a simple formula can generated a needed to calculate velocity in physics. Therefore to predict things like the weather, strong computers are needed.

3. Who are the stake holders?
4. What are the advantages and disadvantages for these stake holders?
5. What solutions can overcome the problems?

The stake holders are those effected by the model correctness, if it is a weather prediction model, everybody is effected, if it is a spacecraft launching model, the astronauts are effected. The advantage of a model is being prepared for evens to come, but at the same time, a model can be wrong. Although models give a good prediction, there is always a chance that they may be wrong. In reality unexpected things can occur, however, if more computing power is available, better models can be formed.

6. What areas of impact does it affect?
7. Evaluate the impact locally and globally.

Thus, because modeling is so widely used in many fields, it has a tremendous impact on the way people live, and in the innovation of science. The impact is both global and local, If models of weather were to correspond with reality 99% of the times, then people's lives can be saved from storms, and every one would know what to wear the next day. Similarly everything would be predictable, however, such precision in modeling can only be achieved with very high computing power, perhaps higher than today's technology allows.